Electronic Services - Los Angeles
M12130X

DUMONT

OSCILLOSCOPE LABORATORIES, INC.

40 FAIRFIELD PLACE WEST CALDWELL, NEW JERSEY 07006

TYPE 7413 PLUG-IN

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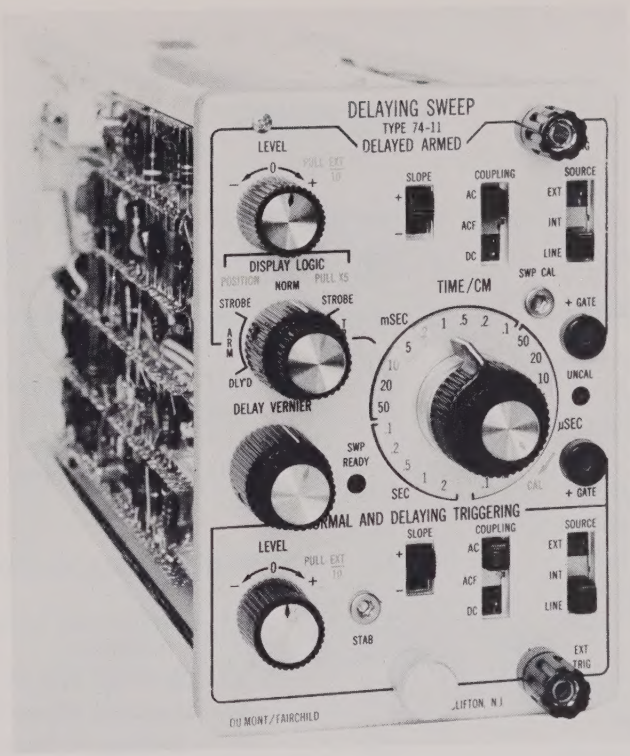


FIGURE 1-1. DU MONT TYPE 74-11 DELAYING SWEEP PLUG-IN

FIGURE 1-2. DU MONT TYPE 74-13 CALIBRATED DELAYING SWEEP PLUG-IN

SECTION 1
OPERATING INSTRUCTIONS

1-1. INTRODUCTION

This Operating and Maintenance Instruction Manual covers information on both the Types 74-11 and 74-13 Time Base Plug-in modules. These modules are designed for use with the Du Mont Type 745/765 Series Oscilloscopes. Electrically, the two types are essentially identical, except that the Type 74-13 is provided with a calibrated delay and the Type 74-11 is equipped with an uncalibrated delay. These differences are clearly indicated in the text. Otherwise, references throughout the manual to the Type 74-11 pertain also to the Type 74-13.

1-2. TECHNICAL SUMMARY

The electrical and physical characteristics of the Du Mont Types 74-11 and 74-13 Time Base Plug-ins are listed in Table 1-1 at the end of Section 1.

NOTE: To simplify circuit description, the following abbreviations are employed to describe the dual time base delaying sweeps.

Abbreviation	Description
NDT	The NDT sweep refers to Normal Sweep operation and Delaying Triggered operation (i.e., the delayed sweep starts immediately after the delay pick-off trigger is generated).
DA	The DA sweep refers to Delayed Armed operation (i.e., the delaying sweep [NDT] generates a delay pick-off trigger which arms the DA sweep). A sync trigger is then required to fire the DA sweep.

1-3. FIRST TIME OPERATION (Figures 1-3 to 1-9)

If this is the first time these plug-ins have ever been used, then certain initial adjustments must be made. Refer to Section 2, Maintenance and Recalibration, paragraph 2-13 and make the following adjustments.

1. Strobe Intensity Adjustment (R8012).
2. Strobe Pattern Compensation Adjustment (R8005 and C8004).
3. Delay Zero Adjustment, Type 74-13 only (R8618).

For instructions on normalizing the Plug-in unit to the Main Frame, see paragraph 1-11, Sweep Calibration, in this section.

The following illustrations are designed to aid the operator in becoming familiar with the Delaying Sweep Plug-ins.

Figure 1-3. Type 74-11 Function of Controls and Connectors
Figure 1-4. Type 74-13 Function of Controls and Connectors
Figure 1-5. Type 74-11 Normal Display
Figure 1-6a. Type 74-11 Triggered Strobe Display
Figure 1-6b. Type 74-11 Delayed Triggered Display
Figure 1-7a. Type 74-11 Armed Strobe Display
Figure 1-7b. Type 74-11 Armed Delayed Display
Figure 1-8. Type 74-13 Normal Display
Figure 1-9a. Type 74-13 Triggered Strobe Display
Figure 1-9b. Type 74-13 Delayed Triggered Display

Unless otherwise designated, it is presumed that a Y Amplifier Plug-in module is inserted in the Y cavity (left-hand side) and the Du Mont Type 74-11 or Type 74-13 Time Base Plug-in unit is inserted in the X cavity (right-hand side) of the Main Frame. If the Time Base Plug-in unit is inserted in the Y cavity of the Main Frame, it will provide vertical deflection of the trace and the information must be translated accordingly.

We know that you are anxious to get acquainted with your new instrument. To aid you in this endeavor, you may set up the instrument using the built-in calibrator signal to demonstrate the effects of the various controls on the display.

1-4. SWEEP TRIGGERING

Two trigger circuits are built into the Delaying Sweep plug-ins. Each Time Base is provided with its own separate triggering facility.

To obtain a stable display, the sweep must consistently start at the same time relative to recurring cycles of the input waveform. If the sweep is allowed to occur at random or at a rate unrelated to the rate of occurrence of the input waveform, the displayed pattern will be traced out at a different point on the screen each time the sweep runs. This will either cause the waveform to drift across the screen or to be unintelligible. The sweep therefore must be triggered by the input signal, or by some signal which bears a fixed time relationship to the input signal. For present purposes, the starting of each horizontal wave across the screen may be called "triggering the sweep." The following instructions tell you how to select and use the proper triggering signal for various applications.

1-5. TRIGGER SOURCE SELECTION

a. Internal

For most applications, the sweep may be triggered by the Y input signal. The only requirement is that the signal amplitude be sufficient to trigger the sweep. To obtain triggering of the sweep from the input signal, set the Trigger SOURCE switch to INT. In-

DA EXT TRIG

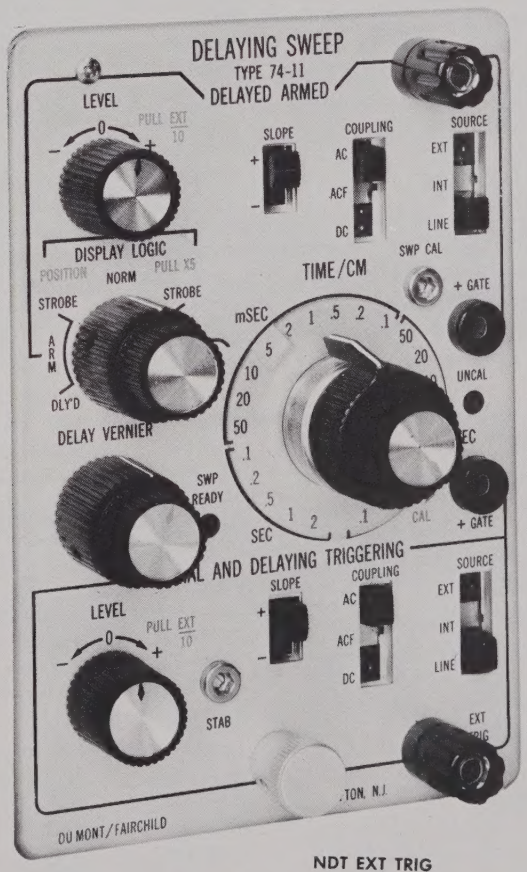
Binding Post: for applying external triggering signal through EXT position of DA TRIGGER SOURCE switch. 1M, 40 pf

DA TRIGGER

Two, 3-position and one 2-position slide switch: enables trigger selection from internal or external SOURCE, direct or capacitive COUPLING, and choice of SLOPE polarities for the Delayed Armed Sweep

DA LEVEL

Control with push-pull switch: selects trigger - signal - voltage level at which DA Sweep is fired. PULL EXT/10 position is available



DA + GATE

Jack tip: provides a positive output pulse coincident with the Delayed Sweep time for operation of auxiliary equipment

UNCAL

Lamp: lights and serves as a warning indicator when using uncalibrated sweep

SWP READY

Lamp: lights whenever DA Sweep is armed and ready to be triggered

NDT + GATE

Jack tip: provides a positive output pulse coincident with the Normal and Delaying Sweep time for operation of auxiliary equipment

NDT TRIGGER

Two, 3-position and one 2-position slide switch: enables trigger selection from internal or external SOURCE, direct or capacitive COUPLING, and choice of SLOPE polarities for the Normal and Delaying Sweep

NDT LEVEL

Control with push-pull switch: selects trigger - signal - voltage level at which NDT Sweep is fired. PULL EXT/10 position is available

NDT EXT TRIG

Binding post: for applying external triggering signal through EXT position of NDT TRIGGER SOURCE switch. 1M, 40 pf

FIGURE 1-3a. TYPE 74-11. FUNCTION OF CONTROLS AND CONNECTORS

POSITION

Concentric control with push-pull switch: permits the positioning of any part of the sweep to within two centimeters of screen center. PULL X5 position provides for 5 times magnification of sweep about screen center

DISPLAY LOGIC

Concentric switch selects the five following sweep displays:

1. Normal (conventional sweep display)
2. Delayed Triggered Strobe
3. Delayed Armed Strobe

   (Items 2 & 3: Delaying Sweep showing Delayed Sweep as a brightened sector)

4. Delayed Armed
5. Delayed Triggered

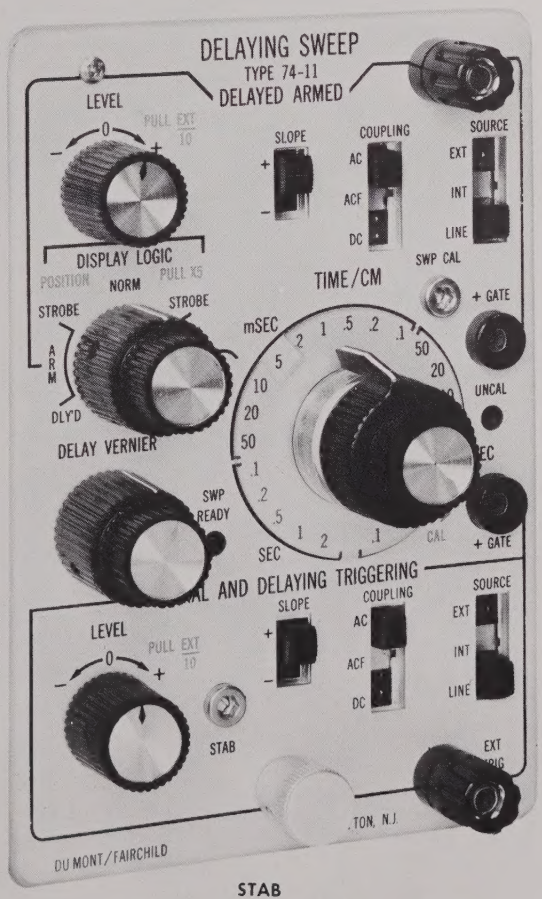
   (Items 4 & 5: Brighten sector — strobe — shown expanded to full scale)

DELAY

Concentric controls: determine the on-screen distance from the NDT sweep-start at which the Delayed Sweep is either triggered or armed

Coarse Delay (outer) knob covers 10 cm of sweep length

Vernier Delay knob provides 2 mm of resolution



SWP CAL

Screwdriver control: permits normalization of the Plug-in unit to the Main Frame

TIME/CM

Concentric controls: select calibrated sweep rates as indicated on the front panel

A push-pull clutch permits the upper knob to engage the lower knob to adjust Normal Sweep and Delaying Sweep (N D T) range (i.e., the two switches may be rotated together through the clutch and the (DA) Sweep range may be declutched and rotated independently)

The VERNIER control provides a continuous, uncalibrated range of sweep rates between the fixed steps of its concentric neighbor

STAB

Screwdriver control: permits improved count-down and lock-in of signals having repetition rates of 5 Mc or greater when using NDT Sweep

FIGURE 1-3b. TYPE 74-11. FUNCTION OF CONTROLS AND CONNECTORS

DA EXT TRIG

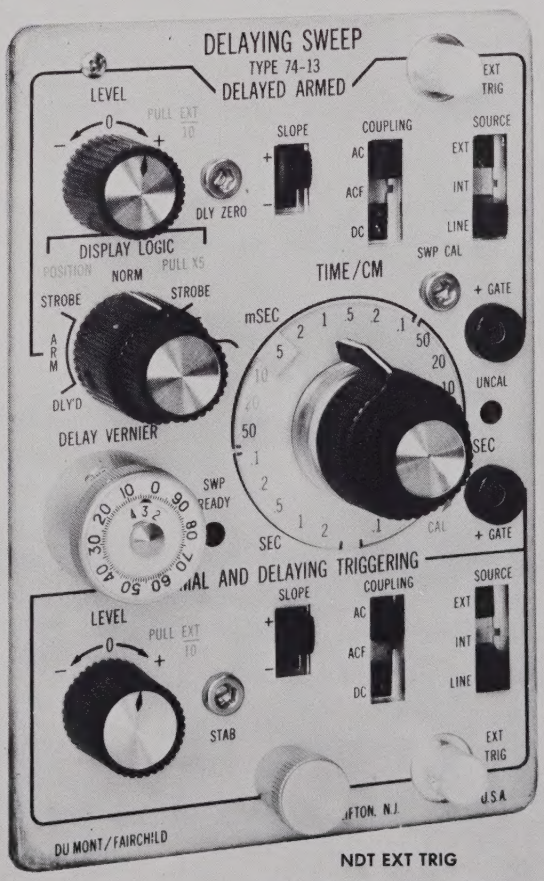
BNC connector: for applying external triggering signal through EXT position of NDT TRIGGER SOURCE switch. 1M, 40 pf

DA TRIGGER

Two, 3-position and one 2-position slide switch: enables trigger selection from internal or external SOURCE, direct or capacitive COUPLING, and choice of SLOPE polarities for the Delayed Armed Sweep

DA LEVEL

Control with push-pull switch: selects trigger - signal - voltage level at which DA Sweep is fired. PULL EXT/10 position is available



DA + GATE

Jack tip: provides a positive output pulse coincident with the Delayed Sweep time for operation of auxiliary equipment

UNCAL

Lamp: lights and serves as a warning indicator when using uncalibrated sweep

SWP READY

Lamp: lights whenever DA Sweep is armed and ready to be triggered

NDT + GATE

Jack tip: provides a positive output pulse coincident with the Normal and Delaying Sweep time for operation of auxiliary equipment

NDT LEVEL

Control with push-pull switch: selects trigger - signal - voltage level at which NDT Sweep is fired. PULL EXT/10 position is available

NDT TRIGGER

Two, 3-position and one 2-position slide switch: enables trigger selection from internal or external SOURCE, direct or capacitive COUPLING, and choice of SLOPE polarities for the Normal and Delaying Sweep

NDT EXT TRIG

BNC connector: for applying external triggering signal through EXT position of NDT TRIGGER SOURCE switch. 1M, 40 pf

FIGURE 1-4a. TYPE 74-13. FUNCTION OF CONTROLS AND CONNECTORS

DISPLAY LOGIC

Concentric switch selects the five following sweep displays:

1. Normal (conventional sweep display)
2. Delayed Triggered Strobe
3. Delayed Armed Strobe

   (Items 2 & 3:
   Delaying Sweep showing Delayed Sweep as a brightened sector)

4. Delayed Armed
5. Delayed Triggered

   (Items 4 & 5:
   Brighten sector — strobe — shown expanded to full scale)

POSITION

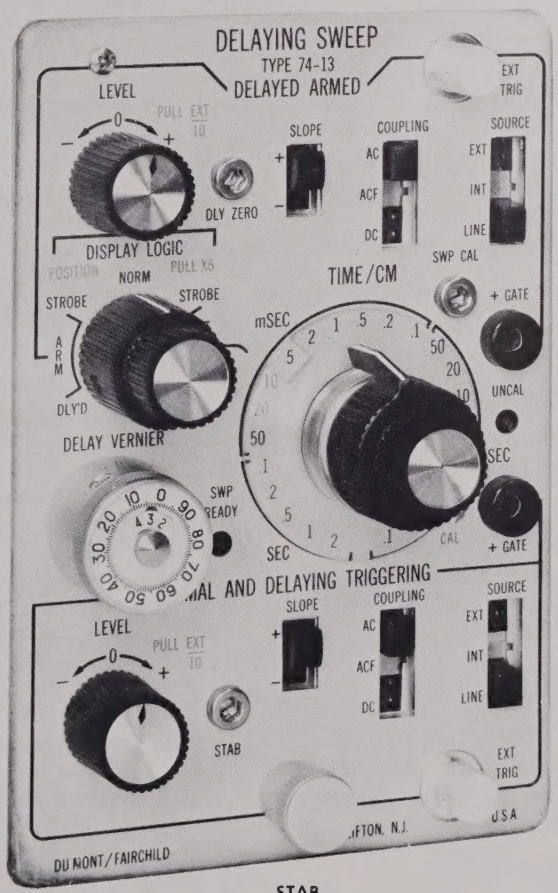
Concentric control with push-pull switch: permits the positioning of any part of the sweep to within two centimeters of screen center. PULL X5 position provides for 5 times magnification of sweep about screen center

DELAY VERNIER

Control: a 10-turn precision potentiometer determines the on-screen distance from the Normal Sweep start at which the Delayed Sweep is either triggered or armed. This control is calibrated in centimeters and functions as an accurate delay multiplier when used with the calibrated TIME/CM range switch

DELAY ZERO

Control: a vernier potentiometer to permit precise DELAY VERNIER zero adjustment



STAB

Screwdriver control: permits improved count-down and lock-in of signals having repetition rates of 5 Mc or greater when using NDT Sweep

SWP CAL

Screwdriver control: permits normalization of the Plug-in unit to the Main Frame

TIME/CM

Concentric controls: select calibrated sweep rates as indicated on the front panel

A push-pull clutch permits the upper knob to engage the lower knob to adjust Normal Sweep and Delaying Sweep (N D T) range (i.e., the two switches may be rotated together through the clutch and the (DA) Sweep range may be declutched and rotated independently)

The VERNIER control provides a continuous, uncalibrated range of sweep rates between the fixed steps of its concentric neighbor

FIGURE 1-4b. TYPE 74-13. FUNCTION OF CONTROLS AND CONNECTORS

ternal triggering is convenient since no external triggering connections are required. Satisfactory results are obtained in most applications.

b. External

Sometimes it is advantageous to trigger the sweep with an external signal. External triggering is especially useful where signals are going to be sampled from several different places within an instrument. With external triggering, the triggering signal usually remains constant in amplitude and shape. Thus, it is possible to observe the shaping and amplification of a signal in an external circuit without resetting the oscilloscope triggering controls for each observation. Also, time and phase relationships between the waveforms at different points in the circuit can be seen. For example, if the external triggering signal is derived from the waveform at the input to a circuit, the time relationship and phase of the waveforms at each point in the circuit are compared to the input signal by the displayed waveform.

When a stable, external triggering signal is used, it is possible to observe and accurately measure jitter of the displayed waveform. This is not possible when the sweep is triggered internally.

External triggering should also be used with a dual-trace amplifier module in the alternate mode to show the proper time relationship between the two displayed signals. To obtain a stable display, the external triggering signal must have an amplitude of at least one volt, peak-to-peak, and bear a fixed time relationship to the displayed signal. To use an external signal for triggering the sweep, connect the signal to the EXT TRIG connector and set the Trigger SOURCE switch to EXT.

c. Line

If the pattern on display bears a fixed time relationship to the power-line frequency, the sweep may be triggered by this signal. To accomplish this, set the Trigger SOURCE switch to LINE.

1-6. TRIGGER COUPLING SELECTION

a. AC Coupling

Selection of the AC triggering mode is accomplished by setting the COUPLING switch to AC. This mode is provided with a high-pass filter that has a low-frequency cut-off nominally at 80 cycles. This feature prevents erratic triggering when positioning the pattern vertically and using internal triggering. In the AC mode, triggering is unaffected by the dc components of the triggering signal or by the vertical positioning of the trace. The triggering level can be selected to provide the desired display via use of the Trig LEVEL control.

When using the AC mode, the Trigger COUPLING switch is set to AC. The trace always starts at the same point on the *Waveform* for a given Trig LEVEL control setting regardless of the vertical positioning.

b. DC Coupling

The DC mode is especially useful for viewing waveforms which change very slowly and which are therefore discriminated against by the low-frequency cutoff of the AC position (80 cps). Because of the coupling network time constant in the AC mode, signals having random repetition rates are sometimes viewed more stably in the DC mode.

This mode permits excellent triggering on all types of waveforms and is most useful in the following applications:

1. For preserving very low frequencies;
2. For maintaining the initial reference position of the trace with respect to the CRT scale at a given Trig LEVEL control setting; and
3. For avoiding trigger point variations due to random repetition rate triggering signals.

When using the DC mode, the Trigger COUPLING switch is set to DC. The trace always starts at the same point on the *Scale* for a given setting of the Trig LEVEL control regardless of the vertical positioning.

c. ACF Coupling

The ACF mode is a special high-frequency form of the AC mode and is used to reject low-frequency components in the triggering signal. Use AC triggering unless low-frequency rejection is required. Triggering signals with frequency components below 10 Kc, for example the calibrator signal, will not initiate the sweep circuits when the ACF mode is used. *Also, the ACF mode will assure stable triggering from the dual-trace plug-in when it is set up for alternate sweep mode, and using internal trigger source.* Thus the ACF mode prevents the difference in positioning level of the two channels from interfering with stable triggering.

Occasionally it is required to obtain stable triggering from a complex high-frequency waveform that contains undesirable low-frequency noise or line-frequency components. In such cases, the additional noise and line pickup may make it difficult to obtain a stable display. If this occurs, select the ACF triggering mode, thereby eliminating the effects of these undesired components. The low-frequency components are blocked from the triggering circuit while the high-frequency triggering waveform is passed to produce the stable triggering that is required. In all other respects, the ACF triggering mode is identical to the AC mode.

1-7. TRIGGER SLOPE SELECTION

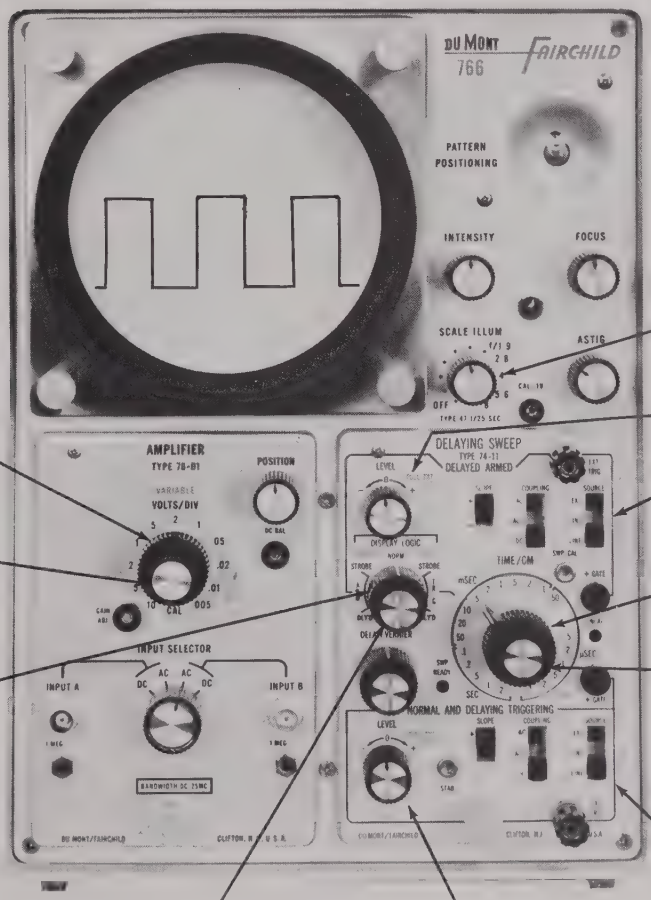
When the Trigger SLOPE switch is set to +, the sweep is triggered on the rising or positive slope of the excitation signal. When the Trigger SLOPE switch is set to —, the sweep is triggered on the falling or negative slope of the excitation signal.

In general, selection of the triggering slope is not crucial, since triggering on either slope will provide a stable display. However, in many other cases, such

NORMAL SWEEP DISPLAY OF CAL SIGNAL

To obtain the calibrator display using NORMAL sweep, set the controls exactly as shown and perform the numbered steps in sequence.

Use the same procedure when difficulty is experienced in obtaining a display. This will eliminate "cockpit" troubles due to misalignment of controls.



Set ASTIG, FOCUS & INTENSITY to center of range

1. Rotate clockwise to turn on the oscilloscope
2. Set to zero
3. Set switches to: + AC & LINE
4. *Set both TIME/CM "clutched knobs" to 5 mSEC
5. Set VERNIER fully clockwise
6. Set switches to: + AC & LINE
7. Set to zero
8. Set outer knob (VOLTS / DIV) to CAL
9. Rotate inner knob (VARIABLE) fully clockwise
10. Set outer knob (DISPLAY LOGIC) to NORMAL
11. Adjust to center the display horizontally

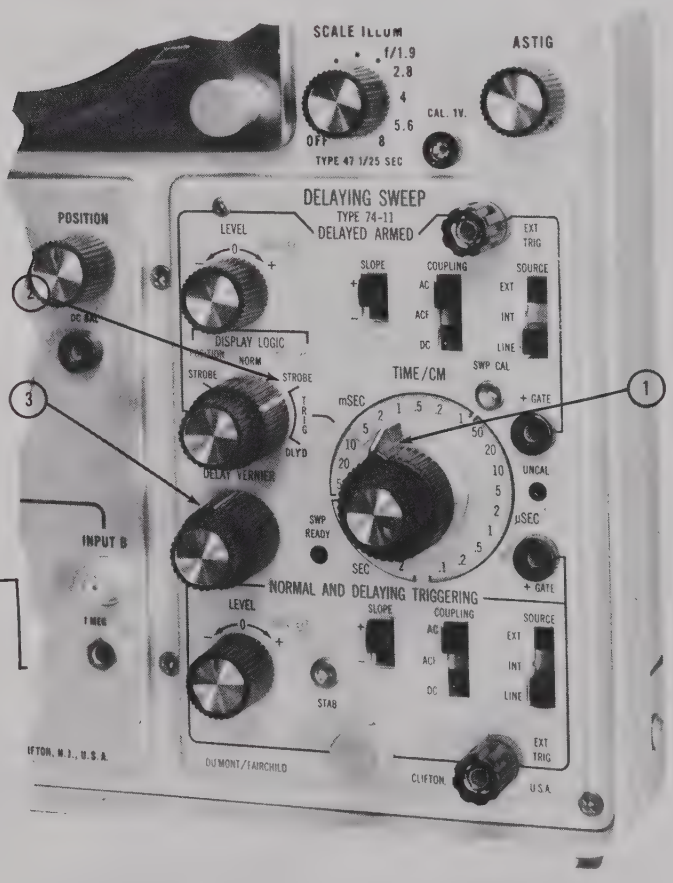
Readjust (POSITION) control on the Y Amplifier to center display vertically

Readjust INTENSITY, FOCUS & ASTIG controls for a sharp pattern

*The TIME/CM "clutched knobs" are engaged when the cutout marker on the plastic skirt is aligned with the white pointer on the clutched knob

FIGURE 1-5. TYPE 74-11 NORMAL DISPLAY

This is a continuation of the initial setup of Figure 1-5. Set the controls exactly as shown and perform the numbered steps in sequence.



Set the DISPLAY LOGIC switch to Triggered STROBE as shown

Adjust DELAY VERNIER control to obtain a pattern very similar to the one shown

Pull out knob to disengage and rotate two steps to the right (1mSEC). The knob with plastic skirt should be pointing to 5 mSEC

Readjust INTENSITY control so that the intensified sector (STROBE) is readily visible

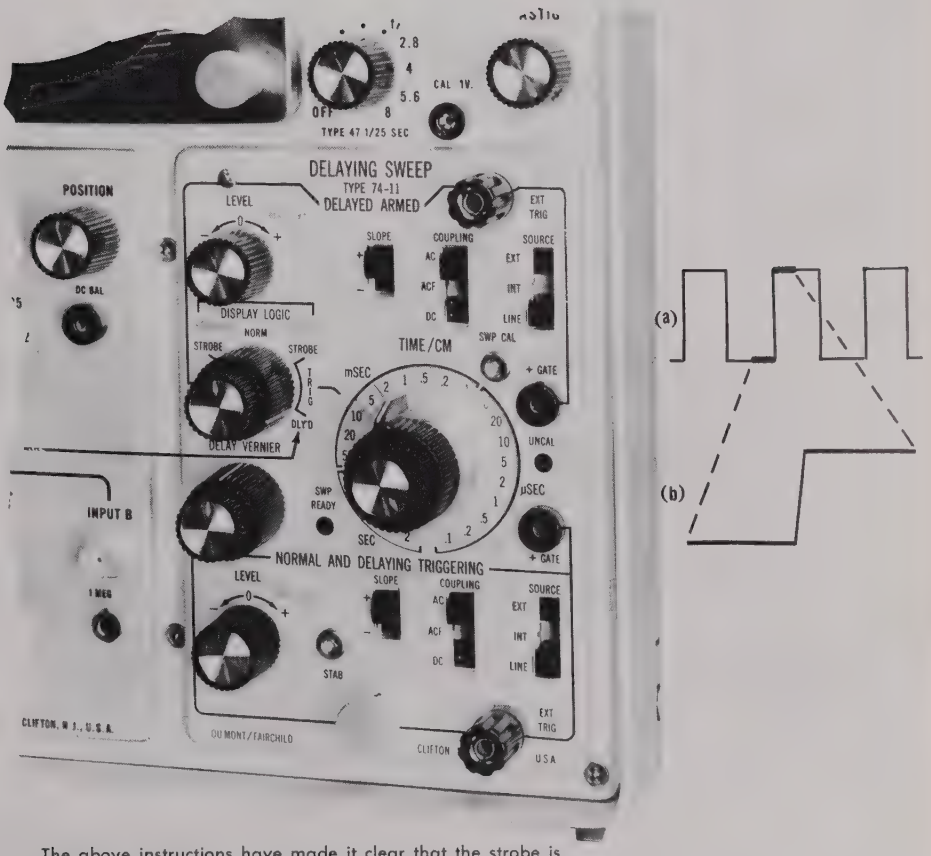
The STROBE setup is useful for indicating what desired portion of the display is to be magnified to full screen when the DISPLAY LOGIC switch is set to the DELAYED position.

The Triggered STROBE mode enables you to select continuously variable delay time. In other words, the strobe may be indexed smoothly along any portion of the waveform.

FIGURE 1-6a. TYPE 74-11 TRIGGERED STROBE DISPLAY

DISPLAY OF CAL SIGNAL

Set DISPLAY LOGIC switch to Triggered DELAYED. The portion of the original display (a) that was brightened (Strobe) will now be expanded to fill the entire scale as indicated in (b). In this instance, the magnification ration is 5 to one



The above instructions have made it clear that the strobe is equal to the time of the Delayed Sweep and that the left-hand side indexes the time delay of the Delayed Sweep from the start of the Normal Sweep. Since the Delayed Sweep represents a section of time with the Normal Sweep display, and since this section may be expanded to full scale, we may consider the Delayed Sweep as a magnified section of the Normal Sweep

FIGURE 1-6b. TYPE 74-11 DELAYED TRIGGERED DISPLAY

This is a continuation of the initial setup of Figure 1-5. Set the controls exactly as shown and perform the numbered steps in sequence.

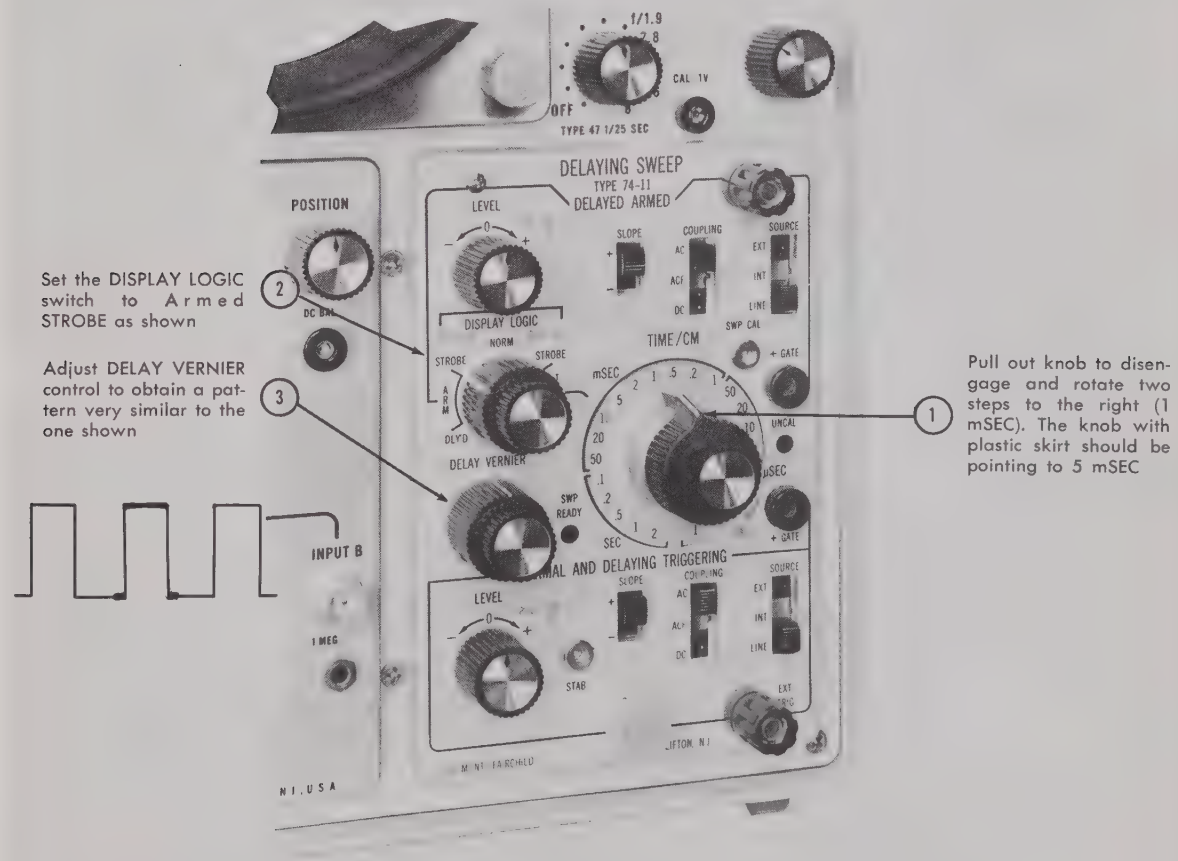
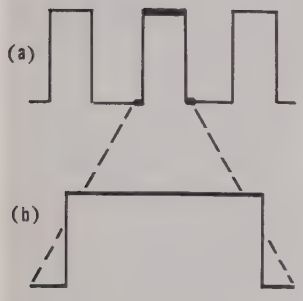
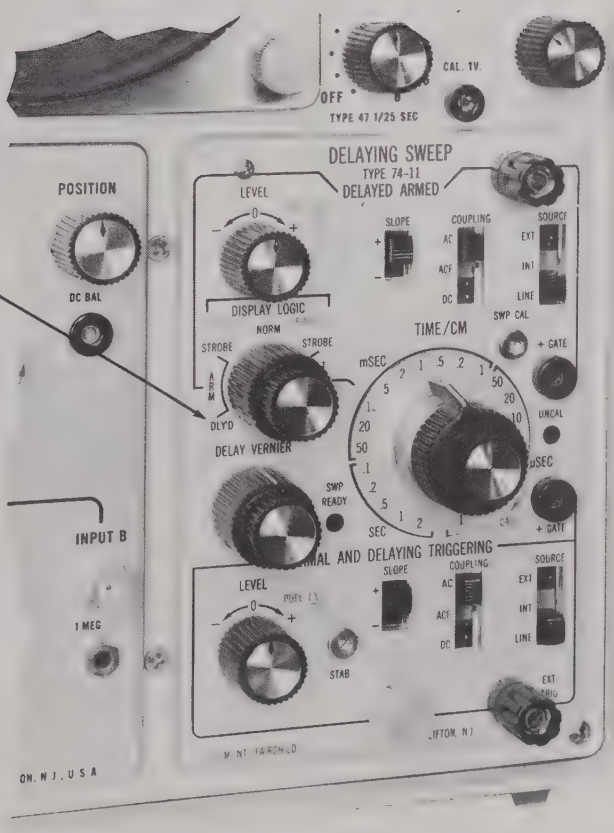


FIGURE 1-7a. TYPE 74-11 ARMED STROBE DISPLAY

DISPLAY OF CAL SIGNAL

Set DISPLAY LOGIC switch to Armed DELAY. The brightened portion of the original display (a) will now be expanded to fill the entire scale as indicated in (b). In this example, the magnification ratio is 5 to one





In the delay-armed mode, the Delayed Sweep does not start precisely at the delay time indicated by the operator, but instead is initiated by the next suitable trigger following the delay interval. Since the sweep is triggered by the input signal, jitter is eliminated from the display even though it is inherent in the input waveform.

FIGURE 1-7b. TYPE 74-11 ARMED DELAYED DISPLAY

as pulse measurements, the triggering slope is very important. If, while using a fast sweep, it is desired to observe the rise of a pulse, it will be necessary to trigger the sweep on the rising portion of the waveform by setting the Trigger SLOPE switch to plus. Conversely, to observe the fall of a pulse while using a fast sweep, it will be necessary to trigger the sweep on the falling portion of the waveform by setting the Trigger SLOPE switch to minus. In either case, selection of the incorrect triggering slope will make it impossible to observe the desired portion of the displayed waveform.

1-8. TRIGGER LEVEL SELECTION

The Trig LEVEL control permits selection of specific voltage which the triggering signal must exceed before the sweep fires. When the Trigger SLOPE switch is set to the + position, adjustment of the Trig LEVEL control makes it possible to trigger the sweep consistently at virtually any point on the positive slope of the excitation signal. Conversely, with the Trigger SLOPE switch set to the — position, adjustment of the Trig LEVEL control makes it possible to trigger the sweep consistently at virtually any point on the negative slope of the excitation signal. The Trig LEVEL control has a nominal range of ±15 volts (Type 74-11) or ±10 volts (Type 74-13) with respect to ground. In PULL EXT/10 position, the leveling range is extended to ±150 volts dc (Type 74-11) or ±100 volts dc (Type 74-13).

1-9. SWEEP OPERATIONAL MODES

a. Introduction

When using the Delaying Sweep Time Base Plug-in, the start of the horizontal sweep can be delayed for a period of from 1 microsecond to 10 seconds after application of the triggering waveform. This is accomplished through simultaneous use of the NDT Time Base and the DA Time Base. In this application, the NDT Time Base is used to provide the accurate time delay while the DA Time Base provides a normal horizontal sweep at the end of the delay period. The duration of the sweep delay is controlled by the NDT TIME/CM and the DELAY VERNIER control settings.

The delayed sweep feature of this instrument may be employed in a number of special applications to increase its versatility. Such applications include high magnification of a selected portion of an undelayed sweep, accurate time measurements, and accurate measurements of waveform jitter. Also, it is possible to pick off and display any desired line of a television scan or to check pulse-time modulation.

b. Sweep Range Indicators

The NDT TIME/CM switch is provided with a knob mounted on a plastic skirt; the DA TIME/CM switch is mounted on top of this knob and is identified by the white pointer. Turning the knob of the latter will permit control of the Delayed Sweep time duration. A push-pull clutch permits the upper knob to engage the lower knob to adjust both sweep ranges simultaneously, or the Delayed Sweep range knob may be declutched and rotated independently.

c. Normal Sweep Display

When the DISPLAY LOGIC switch is set to NORMAL, only the NDT Time Base is displayed. Triggering is derived from the displayed signal internally, or external signals may be applied to the lower EXT TRIG connector. In addition, Line-frequency is available. Refer to Figures 1-5 and 1-8.

d. Triggered Strobe Display

When the DISPLAY LOGIC switch is set to Triggered STROBE, and the Delayed TIME/CM switch is set for a higher sweep rate than the NDT TIME/CM switch, a portion of the sweep may be brightened. (See Figures 1-6a, 1-7a, and 1-9a.) The start of the brightened portion (Strobe) indicates the start of the Delayed Sweep and the length of the strobe indicates the Delayed Sweep duration. The start of the strobe may be positioned left or right with the DELAY VERNIER control. The length of the strobe may be adjusted with the Delayed TIME/CM control. Note that the start of the strobe is not affected by the setting of the latter control. Using these two controls, it is possible to include any portion of the display waveform in the brightened or strobed area.

The amount of delay occurring from the application of the triggering waveform until the Delayed Sweep is permitted to run, is indicated directly by the setting of the NDT TIME/CM switch and the DELAY VERNIER control. The setting of these two controls are multiplied together to obtain the actual delay time. For example, if the NDT TIME/CM switch is set to 5 mSEC and the DELAY VERNIER dial indicates 3 (Type 74-13), the delay time is 15 milliseconds. The Delayed Sweep will occur immediately at the end of the preset delay period. This mode from now on will be referred to as the Delayed-Triggered sweep mode. It is the mode of operation that permits the operator to select continuously variable (calibrated Type 74-13 only) delay times for making accurate time and waveform jitter measurements.

The Delayed Sweep automatically shuts off when the Normal Sweep is terminated. This prevents brightening of the sweep retrace in either of the STROBE positions.

e. Delayed Triggered Display

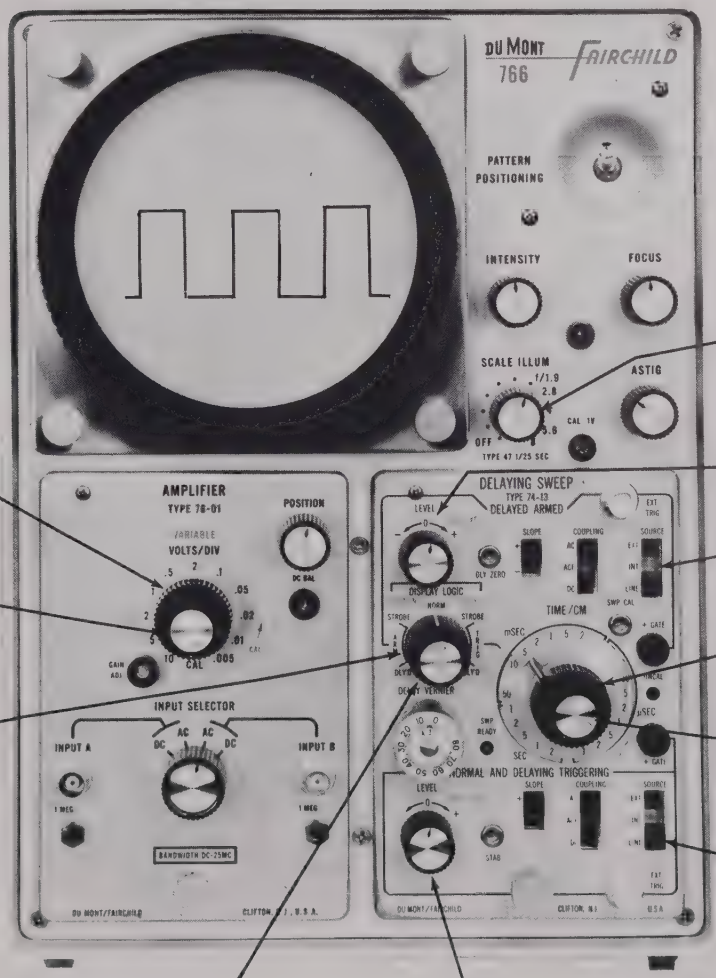
When the DISPLAY LOGIC switch is set to Triggered DELAYED, the brightened section of the display in the STROBE position is now expanded to full scale. See Figures 1-6b, 1-7b, and 1-9b.

The amount of magnification is the ratio of the NDT sweep rate to the Delayed Sweep rate. The magnification ratio may be expressed:

NORMAL SWEEP DISPLAY OF CAL SIGNAL

To obtain the calibrator display using NORMAL sweep, set the controls exactly as shown and perform the numbered steps in sequence.

Use the same procedure when difficulty is experienced in obtaining a display. This will eliminate "cockpit" troubles due to misalignment of controls.



Set ASTIG, FOCUS & INTENSITY to center of range

(1) Rotate clockwise to turn on the oscilloscope

(2) Set to zero

(3) Set switches to: + AC & LINE

(4) *Set both TIME/CM "clutched knobs" to 5 mSEC

(5) Set VERNIER fully clockwise

(6) Set switches to: + AC & LINE

(7) Set to zero

(8) Set outer knob (VOLTS / DIV) to CAL

(9) Rotate inner knob (VARIABLE) fully clockwise

(10) Set outer knob (DISPLAY LOGIC) to NORMAL

(11) Adjust to center the display horizontally

Readjust (POSITION) control on the Y Amplifier to center display vertically

Readjust INTENSITY, FOCUS & ASTIG controls for a sharp pattern

*The TIME/CM "clutched knobs" are engaged when the cutout marker on the plastic skirt is aligned with the white pointer on the clutched knob

FIGURE 1-8. TYPE 74-13 NORMAL DISPLAY

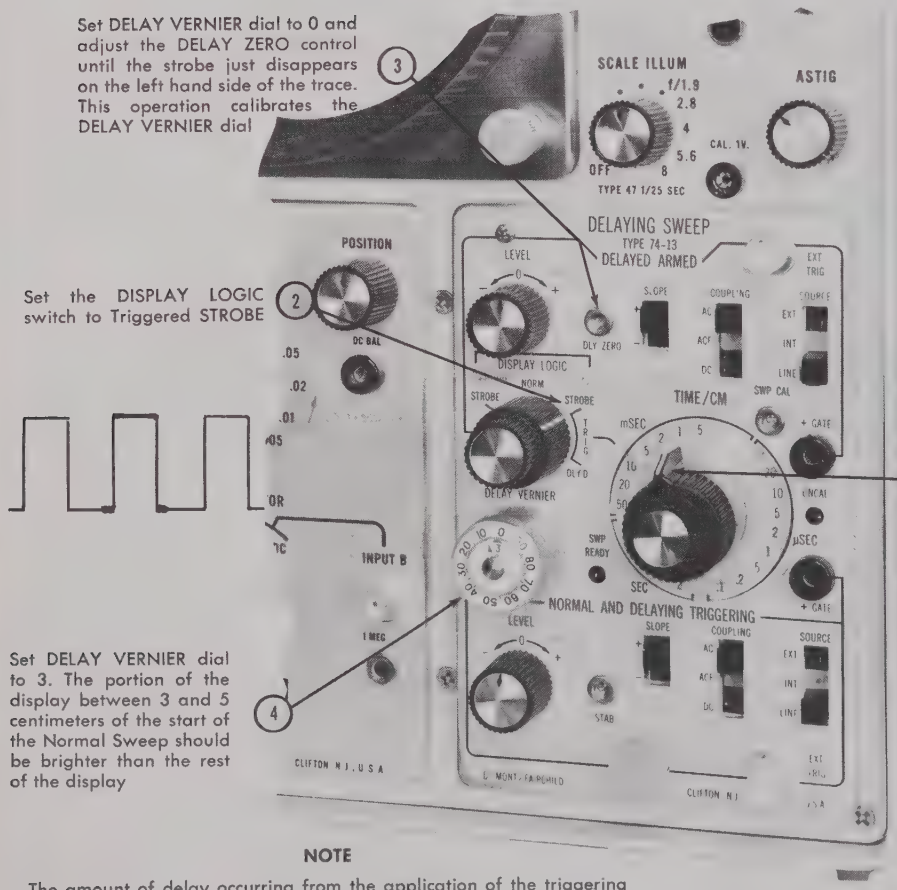
This is a continuation of the initial setup of Figure 1-8. Set the controls exactly as shown and perform the numbered steps in sequence.

Set DELAY VERNIER dial to 0 and adjust the DELAY ZERO control until the strobe just disappears on the left hand side of the trace. This operation calibrates the DELAY VERNIER dial

Set the DISPLAY LOGIC switch to Triggered STROBE

Pull out knob to disengage and rotate two steps to the right (1 mSEC). The knob with plastic skirt should be pointing to 5 mSEC

Set DELAY VERNIER dial to 3. The portion of the display between 3 and 5 centimeters of the start of the Normal Sweep should be brighter than the rest of the display

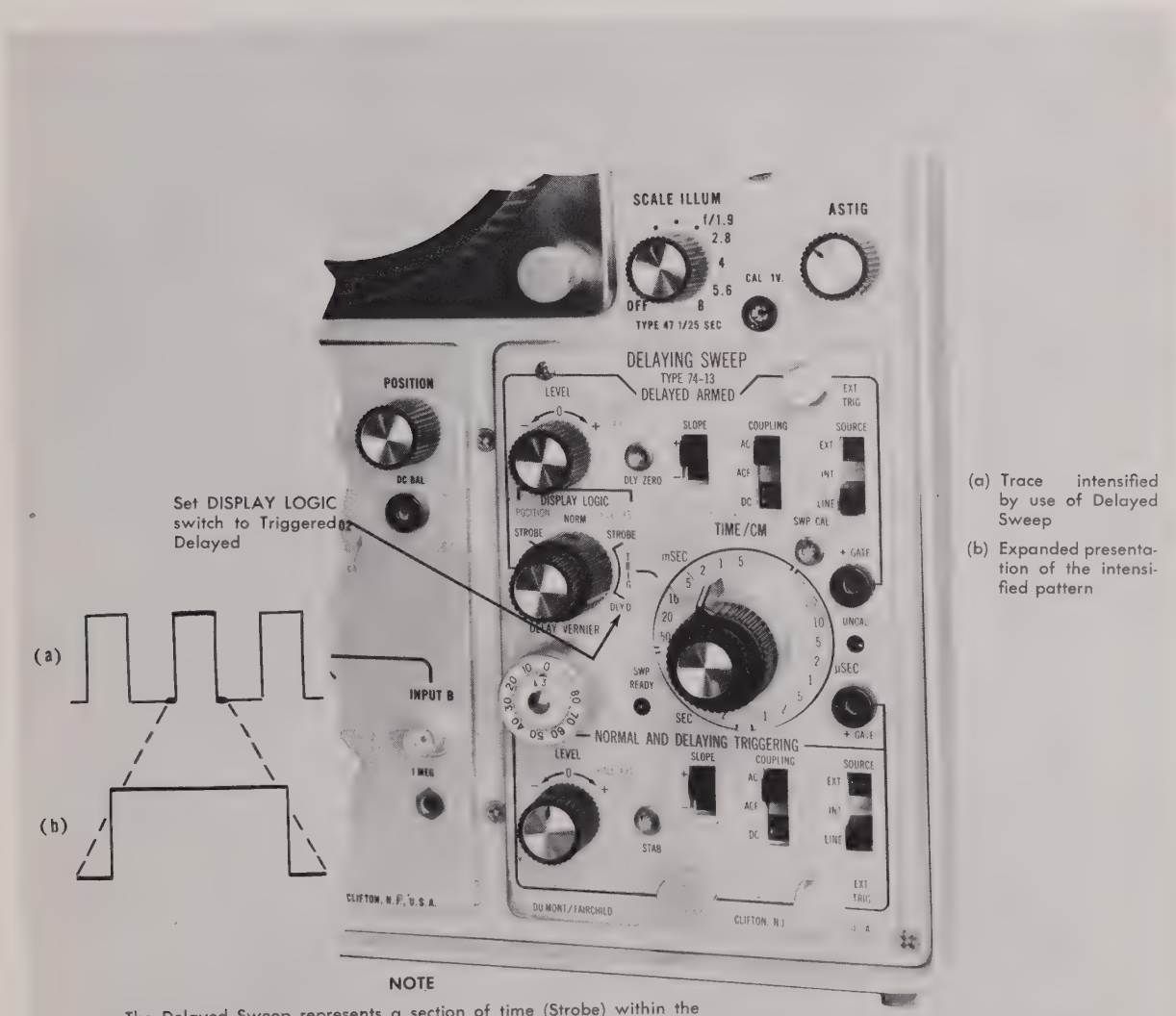


NOTE

The amount of delay occurring from the application of the triggering signal until the Delayed Sweep starts, is indicated directly by the setting of the NDT TIME/CM switch (plastic skirt) and DELAY VERNIER dial. In this instance the NDT sweep rate of 5 mSec/Cm is multiplied by the DELAY VERNIER dial setting of 3 cm yielding a calibrated delay time of 15 milliseconds. The above applies only when the delayed-triggered operational mode is used.

FIGURE 1-9a. TYPE 74-13 TRIGGERED STROBE DISPLAY

DISPLAY OF CAL SIGNAL



(a) Trace intensified by use of Delayed Sweep

(b) Expanded presentation of the intensified pattern

NOTE

The Delayed Sweep represents a section of time (Strobe) within the Normal Sweep display and this section may be expanded to full scale. Hence the Delayed Sweep may be considered as a calibrated, magnified section of th NDT sweep. The magnfication ratio may be expressed:

$$\frac{\text{NDT Sweep Rate}}{\text{DA Sweep Rate}}$$

In this instance we have: $\frac{5 \text{ mSEC/CM}}{1 \text{ mSEC/CM}} = 5$

FIGURE 1-9b. TYPE 74-13 DELAYED TRIGGERED DISPLAY

$$\text{magnification ratio} = \frac{\text{Normal Sweep Rate (Time/Cm)}}{\text{Delayed Sweep Rate (Time/Cm)}}$$

For example, if the NDT TIME/CM switch is set to 1 mSEC, and the Delayed TIME/CM switch is set to 1 μSEC, the brightened portion of the sweep is magnified horizontally 1000 times when the DISPLAY LOGIC switch is set to the Triggered DELAYED position.

Automatic provision is made for shutoff of the Normal Sweep when the Delayed Sweep is terminated. This permits maximum duty cycle performance in the DELAYED MODE.

f. Delayed-Armed Operation

If the display is set for Delayed-Armed operation, the delayed sweep does not start at the end of the indicated delayed period until a triggering pulse is applied to the DA trigger circuit. This triggering pulse may be either the input waveform to the oscilloscope or an externally-derived triggering signal. The triggering Source, Coupling, Slope, and Level may be selected in the same manner as for the conventional STROBE and DELAYED triggered operation. In the DELAYED-ARMED mode of operation, the Delayed Sweep does not start precisely at the delay time indicated by the DELAY VERNIER and NDT TIME/GM control setting, but instead is initiated by the next suitable triggering following the indicated delay interval. This mode from now on will be referred to as the Delayed-Armed mode of sweep operation. See Figures 1-7a and 1-7b.

The armed delayed time display does not appear to be continuously variable. The Armed mode should be used whenever the signal to be displayed has accumulative jitter between the start of the normal sweep and the delayed magnified section.

1-10. SWEEP EXPANDER

When the POSITION control knob is pulled out, the sweep may be expanded horizontally by a factor of 5 about the screen center. Thus, to achieve a X5 expansion of a desired segment of the trace, set that segment of interest to the screen center with the POSITION control and pull out this control. Any portion of the expanded display may be observed by adjusting the POSITION control.

When the instrument is set up for X5 expansion of the sweep, the sweep rate indicated by the setting of the TIME/CM control must be divided by 5 to obtain the actual time required for the spot to move one centimeter. For example, if the TIME/CM control is set to 5 mSEC, the actual time per centimeter is 5 milliseconds, divided by 5, or 1 millisecond per centimeter.

1-11. SWEEP CALIBRATION ADJUSTMENT

Whenever the Time Base Plug-in is removed from the Main Frame and inserted in another, the front-panel screwdriver SWP CAL control must be reset. This procedure is necessary to compensate for difference in deflection plate sensitivities. In addition, if the Time Base unit is switched from the X cavity to the Y cavity of the same Main Frame, readjustment will be necessary since the difference in average deflection plate voltages between modules affects the over-all deflection sensitivity of the cathode-ray tube. To properly normalize the gain between channels or between the plug-in unit and the Main Frame, proceed as follows:

1. Set up the instrument for NORMAL display of the CAL signal. (See Figure 1-5 or Figure 1-8.)
2. Set TIME/CM switch to 10 mSEC.
3. Adjust SWP CAL front-panel screwdriver control for precisely 6 cycles of the calibrator display (60-cycle line) in 10 centimeters.

A more accurate method for normalizing the entire sweep range is to employ a Tektronix Type 180A Time-Mark Generator (or equivalent) and determine the sweep range in greatest error. When this "most-off" range has been located, readjust the SWP CAL control to just bring this range within the ±3% of the absolute value represented by the Time-Mark Generator.

1-12. TIME MEASUREMENTS

a. How to Make Elapsed Time Measurements Using the CRT Scale

Any horizontal distance on the screen of the oscilloscope can be used to represent a precise interval of time when the Time Base circuits are set up for calibrated sweep (VARIABLE TIME/CM control set to CAL). Use of this feature permits you to accurately measure the elapsed time between the desired points of interest on the display. To measure the time interval, proceed as follows:

1. Using the calibrated scale, measure the horizontal distance in centimeters between that portion of the display whose time interval you wish to find.
2. Multiply the horizontal dimension obtained in step 1 by the TIME/CM control setting to obtain the time interval. See Figure 1-10.

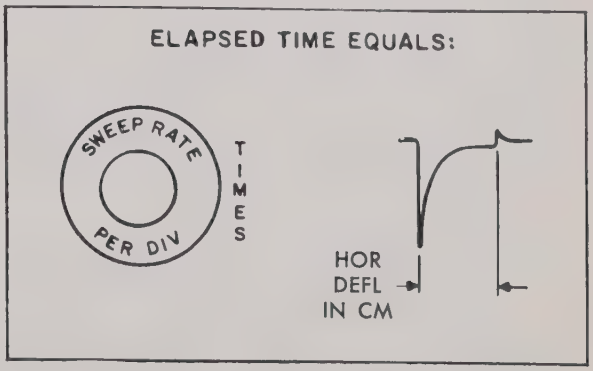


FIGURE 1-10. ELAPSED TIME MEASUREMENT

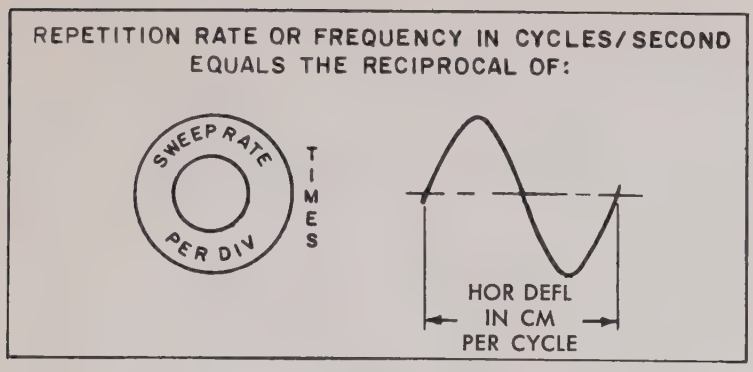


FIGURE 1-11. FINDING THE FREQUENCY

b. How to Find Repetition Rate or Frequency Using the CRT Scale

The repetition rate or frequency for periodic signals can be expressed as the number of cycles or pulses per unit of time (VARIABLE TIME/CM control set to CAL). To use the oscilloscope for measuring the repetition rate or frequency of periodic signals, proceed as follows:

1. Using the calibrated scale, measure the horizontal distance in centimeters occupied by one cycle of the display under observation.
2. Multiply the horizontal dimension obtained in step 1 by the TIME/CM control setting.
3. Take the reciprocal of the product obtained in step 2 (that is, divide it into one). The resulting quotient is the desired frequency or repetition rate in cycles per second. See Figure 1-11.

$$\text{Cycles/second} = \frac{1}{\text{Time (seconds)}}$$

1-13. PHASE-SHIFT MEASUREMENTS

To measure the phase difference between two sine waves proceed as follows:

1. Set up the Delaying Sweep Time Base for externally triggered normal sweep operation.
2. Apply one of the sine waves to INPUT A and the other to INPUT B of the Type 76-01 Amplifier. Set INPUT SELECTOR switch to INPUT A, AC.
3. Adjust the TIME/CM switch until at least one cycle of the display is observed.
4. Position the display so that one of the positive slopes crosses the horizontal center line at the left hand side of the scale.
5. Measure the horizontal distance occupied by one cycle of the waveform. Label this distance A.
6. Set the INPUT SELECTOR switch in the Type 76-01 Amplifier to INPUT B, AC. If a phase difference has occurred between the two input sine waves, the display will shift horizontally.
7. Measure the horizontal shift of the INPUT B display. Label this distance B.
8. Divide the distance measured in step 6 by the distance measured in step 4 and multiply the quotient by 360°. The resulting product is the phase difference between the two sine waves. See Figure 1-12.

$$\text{Phase-shift difference} = \phi = \frac{B}{A}\ 360°$$

NOTE: Waveforms A and B can be made to appear simultaneously if a Type 76-02 Dual Trace Amplifier is used.

1-14. GATE OUTPUT

A positive gate coincident with the sweep output is available on a front-panel BNC connector labeled GATE OUT. The gate amplitude is 2.5 volts nominal into an impedance of 5000 ohms shunted by less than 15 pf. This positive pulse may be used to trigger other devices in order to achieve sufficient delay to view the output of such devices completely displayed on the oscilloscope.

Use of the gate output in conjunction with triggered pulse generators will permit this instrument to display the leading edge of the pulse waveform even though no signal delay is incorporated in the Y Amplifier.

The period of the positive gate may, of course, be measured extremely accurately with an electronic counter. Since the period of the gate output is a direct measure of total sweep time, it is possible to use this oscilloscope in conjunction with a counter to digitize the time duration of input signals. Use of the TIME/CM and the VARIABLE controls will permit the operator to display the waveform to be measured over the entire sweep. Timing accuracies of 1 part in 10^7 are thus readily obtainable.

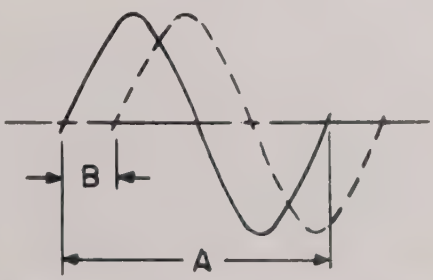


FIGURE 1-12. PHASE-SHIFT MEASUREMENT

TABLE 1-1
TECHNICAL SUMMARY
DU MONT TYPES 74-11 & 74-13 DELAYING SWEEP PLUG-INS

TYPE 74-11/74-13 TRIGGERING SYSTEM

Two trigger circuits are built into the Delaying Sweep plug-ins. Each Time Base is provided with its own separate triggering facility.

TRIGGER SOURCE	A three-position slide switch provides selection of internal, external, and line-frequency triggering
TRIGGER COUPLING	A three-position slide switch provides the following selections:
DC	Direct coupled triggering is provided to: (1) preserve very low frequencies, (2) maintain the initial reference position of the trace with respect to the CRT scale at a given trigger level setting, and (3) avoid trigger point variations due to random repetition rate trigger signals
AC	AC triggering with high-pass filter having low-frequency cutoff nominally at 80 cycles. This feature prevents erratic triggering when positioning the pattern vertically and using internal triggering
ACF	ACF triggering with high-pass filter having low frequency cutoff nominally at 10 Kc to assure stable triggering from the dual trace plug-in used in alternate sweep mode. (This prevents the change in dc position level from Channel A and Channel B from affecting triggering)
TRIGGER SLOPE	A two-position slide switch enables selection of positive or negative triggering signals
TRIGGER LEVEL	The Trig LEVEL control has a nominal range of ±15 volts (type 74-11) or ±10 volts (type 74-13) with respect to ground.
TRIGGER SENSITIVITIES	
Internal (Trigger from 25 Mc Dual Trace Plug-in)	1 centimeter peak-to-peak vertical deflection signal to 1 Mc (Rep. Freq.) 3 centimeters peak-to-peak vertical deflection signal to 10 Mc (Rep. Freq.) A front-panel screwdriver sweep STAB control may be used to improve count down and lock-in of signals having repetition rate of 5 Mc or greater
External (X1 range)	1 volt peak-to-peak to 1 Mc (Rep. Freq.) 3 volts rms to 10 Mc (Rep. Freq.) External trigger input impedance is 1 megohm shunted by 40 pf (nominal)
External (X10 range)	A ten-to-one attenuator is provided in the external trigger channel to extend the dc leveling capability to ±150 volts dc (type 74-11) or ±100 volts dc (type 74-13)

TYPE 74-11/74-13 TIME BASE SYSTEM

SWEEP RANGE (Applies to both time base generators)	
Calibrated Sweep	From 2 seconds/cm to 0.1 microsecond/cm in 23 steps. Step sequence in 1, 2, and 5
Accuracy	±3%

TABLE 1-1. TECHNICAL SUMMARY (Continued)

Uncalibrated Sweep	Continuously variable, uncalibrated between ranges and extends the 2 seconds/cm range to 5 seconds/cm. The UNCAL lamp is lit and serves as a warning indicator when using uncalibrated sweep. Vernier control applies to Normal and Delayed Sweep only
Sweep Range Indicator	Push-pull clutch knob permits simultaneous or independent control of the NDT and DA sweep rates
SWEEP EXPANDER	A calibrated X5 sweep expander in the X output amplifier will expand the sweep about screen center; extends fastest sweep rate to 20 nanoseconds/cm. Expander accuracy is ±5% for speeds faster than 200 nanoseconds/cm
SWEEP MODES	A five-position switch selects the following displays:
Normal Sweep Operation	Conventional sweep display; internally, or externally applied signals continuously trigger or drive the NDT time base circuit
Delayed-Triggered Strobe	Delaying sweep display showing the delayed sweep as a brightened sector. The delayed sweep starts immediately after the delay pick-off trigger is generated
Delayed-Armed Strobe	Delaying sweep display showing the delayed sweep as a brightened sector, but delayed sweep (brightened sector) is armed and initiated by a sync trigger The delayed sweep automatically shuts off when the delaying sweep is terminated. This prevents brightening of the sweep retrace in both STROBE positions
Delayed Triggered or Delayed Armed	The brightened sector of the strobe sweep displays are expanded to full-scale in either of the DELAYED modes. Automatic provision is made for shut-off of the delaying sweep (NDT) when the delayed sweep (DA) terminates. This permits maximum duty cycle performance in the DELAYED mode
Single Sweep (Delayed armed sweep only)	The single sweep mode permits but one driven sweep of the Time Base to appear on the screen until the sweep is reset or rearmed. The single sweep may be rearmed by turning the NDT Trigger Level control The SWEEP READY indicator is lit whenever the delayed sweep gate multivibrator is armed and ready to be triggered
SWEEP CALIBRATION	A front-panel screwdriver SWP CAL control is provided to permit normalization of the plug-in unit to the Main Frame
HORIZONTAL POSITIONING	A horizontal positioning control permits the positioning of any part of the sweep to within two centimeters of screen center

Note: All measurements are taken beyond the first 50 nanoseconds of sweep time.

TYPE 74-11 DELAY TIME SYSTEM

DELAY TIME CONTROLS	Two concentrically mounted potentiometers determine the on-screen distance from the delaying sweep (NDT) start at which the delayed sweep is either triggered or armed The knob adjacent to the panel is the coarse Delay control and it encompasses 10 cm of sweep length. The inner concentric knob serves as a vernier Delay control, providing 2 mm of vernier resolution

TABLE 1-1. TECHNICAL SUMMARY (Continued)

CALIBRATION	The delay pickoff point is not calibrated. However, complete counterclockwise rotation of both DELAY control knobs permits the minimum delay to be within 5 mm of time zero on the normal (NDT) sweep. Note that negative pickoff time will not start the delayed (DA) sweep
DELAY RANGE	From less than 1 microsecond to more than 10 seconds In the Delay mode, the NDT sweep automatically terminates when the DA sweep is completed. The latter operating mode optimizes display repetition rate

TYPE 74-13 CALIBRATED DELAY TIME SYSTEM

DELAY TIME CONTROL	A ten-turn precision potentiometer determines the on-screen distance from the delaying sweep (NDT) start at which the delayed sweep is either triggered or armed
CALIBRATION	The DELAY Time control is calibrated to read from zero to 10 centimeters. This control functions as a Delay Multiplier when used in conjunction with the Delayed TIME/CM control Zero delay is adjustable from the front panel. For extreme accuracy, any or all steps can be adjusted to an external standard from the front panel Incremental accuracy of the ten-turn calibrated control is within 0.25%
DELAY RANGE	Calibrated from a minimum of 1 microsecond to more than 10 seconds

Note: The Types 74-11 and 74-13 Modules differ only in delay pickoff calibration characteristics

OTHER CHARACTERISTICS OF THE TYPE 74-11/74-13

GATE OUT	A pin jack front-panel connector provides a positive-going pulse of 2.5 volts nominal. Output impedance is 5000 ohms, and load impedance should be greater than 100K ohms shunted by less than 15 pf. Gate is referenced directly to ground and is time-coincident with the sweep
OTHER CONTROLS	Internal controls optimize settings of automatic strobe intensity and strobe transition. This normalizes the plug-in to the CRT of the Main Frame and avoids having to reset the intensity control when observing strobed display modes
ENVIRONMENTAL SPECIFICATIONS	Identical to Main Frame
X PLUG-IN INSTALLED IN Y CIRCUITRY	The Types 74-11 and 74-13 Time Base Plug-ins may be inserted in the Y cavity of the Type 765 Series Oscilloscopes; when installed in the Type 765 Series, the sweep rate calibration will be multiplied by a factor of 2

SECTION 2
MAINTENANCE AND RECALIBRATION

2-1. INTRODUCTION (Figures 2-1 to 2-12)

This section of the Instruction Manual contains the circuit description, trouble-shooting instructions, and calibrating procedures for the Du Mont Types 74-11 and 74-13 Time Base Plug-in Units.

To simplify circuit description, functional block and waveform timing diagrams at various DISPLAY LOGIC switch settings are provided as follows:

Figure 2-1. Trigger Circuit (NDT or DA) Functional Block Diagram

Figure 2-2. Normal Sweep Mode, Functional Block Diagram

Figure 2-3. Timing Diagram for Normal Sweep Display

Figure 2-4. Triggered Strobe Mode, Functional Block Diagram

Figure 2-5. Simplified Timing Diagram for Triggered Strobe Display

Figure 2-6. Delayed Triggered Mode, Functional Block Diagram

Figure 2-7. Simplified Timing Diagram for Delayed-Triggered Display

Figure 2-8. Armed Strobe Mode, Functional Block Diagram

Figure 2-9. Simplified Timing Diagram for Delayed-Armed Strobe Display

Figure 2-10. Delayed-Armed Mode, Functional Block Diagram

Figure 2-11. Simplified Timing Diagram for Delayed-Armed Display

Figure 2-12. Horizontal Deflection Amplifier, Functional Block Diagram

The timing diagrams show waveforms at critical points in the circuit and in proper relative time relationship. In addition, a capsule description of each waveform is provided.

The circuit description will be keyed to the aforementioned illustrations. Emphasis is placed on the interrelation of circuits rather than on detail of operation. It is also recommended that the schematics at the rear of the manual be refererd to in following the circuit description.

2-2. TRIGGER CIRCUIT DESCRIPTION, NDT or DA (Figure 2-1)

Since the input of the Normal and Delaying triggering circuit (NDT) is identical to that of Delayed Armed (DA) trigger circuit, only the NDT circuit will be discussed.

The input to the trigger amplifier, V8201 and V8202, may be selected from one of three sources via the TRIGGER SOURCE switch as follows:

1. In EXT or EXT/10 position, the signal is obtained from an external source through the EXT TRIG front-panel connector;

2. in INT position, the signal is derived from the Y Plug-in unit; and

3. in LINE position, the signal is tapped from one side of the 6.3 VAC heater circuit.

A choice of AC, ACF, or DC coupling is provided by the TRIGGER COUPLING switch. In the AC position, the trigger signal is applied to a high-pass filter consisting of C8203, C8206, R8206 and R8207, providing a low-frequency cutoff of 80 cycles. The low-frequency is raised to 10 Kc in the ACF position and the high-pass filter now has R8204 shunting R8207. In the DC position, the high-pass filters are disconnected and the triggering signal is applied directly to the trigger amplifier. The RC network, R8206 and C8206, in series with the grid of V8201 or V8202, serves to protect the input circuit from damage due to excessive input voltage. Shunt capacitor C8206

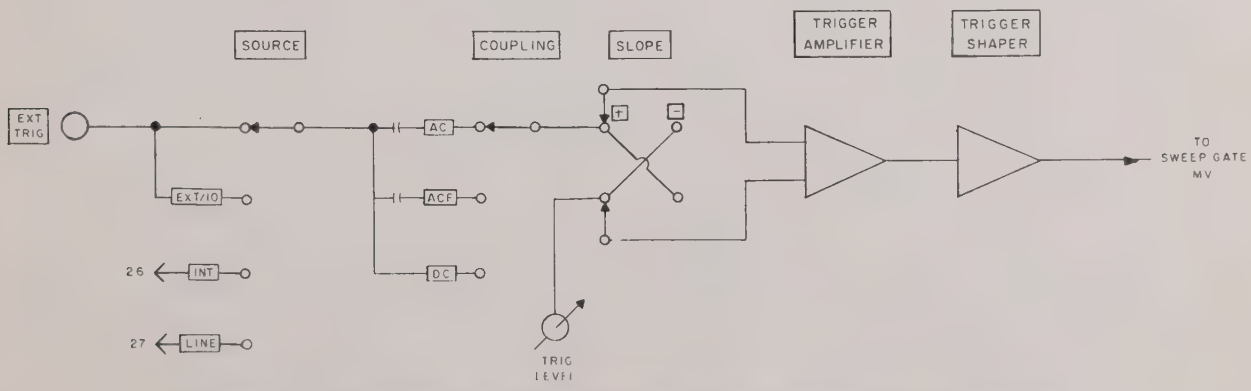


FIGURE 2-1. TRIGGER CIRCUIT (NDT or DA), FUNCTIONAL BLOCK DIAGRAM

(across R8206) preserves the high-frequency signal component.

The negative pulse at the output of the trigger amplifier occurs only when there is a positive-going signal at the input. However, it is desirable to start the sweep during either a positive-going or negative-going portion of the excitation signal. To accomplish this, the TRIGGER SLOPE switch is used to select the desired polarity of the triggering signal.

For positive-going signals, connection is made to the grid of V8201, and for negative-going signals, connection is made to the grid of V8202. In each case, the opposite grid is connected to a dc bias source, adjustable by means of the TRIG LEVEL control R8222. This control is used to select the level of the triggering point for all settings of the TRIGGER SLOPE switch.

The output from V8201 or V8202 is applied to a trigger shaper Q8202 which drives the trigger coupling transformer T8201. The resulting negative trigger is applied to a series coupling diode CR8203 to the base of the delaying sweep gate multivibrator.

The TRIG SENS adjustment, R8229, sets the level of Q8201 and Q8202 through tunnel diode, CR8201, so that no readjustment of the TRIG LEVEL control is required when the TRIGGER SLOPE switch is set from plus to minus slopes or vice versa. This adjustment is made when the TRIG LEVEL control is set to zero.

2-3. CIRCUIT DESCRIPTION OF NORMAL SWEEP (Figures 2-2 and 2-3)

a. Delaying Sweep Gate Multivibrator

The input triggering signal is applied to the base of transistor, Q8206, through series coupling diode, CR8203. The dc coupled bistable multivibrator, Q8206 and Q8207, initiates the formation of the Normal Sweep upon receipt of this negative trigger from the trigger shaper and holds off subsequent triggering signals until after the sweep is completed. In the quiescent state, Q8206 is conducting and Q8207 is at cutoff. Q8206 forms a positive gate while Q8207 forms a negative gate during the forward sweep interval.

CR8203 serves as a high back-impedance diode to couple only negative triggers from the trigger shaper to initiate the sweep. After the bistable multivibrator has been triggered, it will revert to its original state as determined by the setting of the SWEEP LENGTH adjustment, R8263.

b. Saw Generation

The saw generator is of the Miller "run-up" type, V8203. The negative output pulse developed at the collector of Q8207 is applied to the disconnect diodes, CR8216, CR8209 and CR8211. The anode voltages of these diodes are now below their cathodes, and the diodes no longer conduct. This action removes the restraint imposed on the sweep-charging network and now permits the selected sweep capacitor to charge linearly through Q8203, Q8204 and the associated resistance network.

When the grid of the Miller integrator moves negatively, the plate voltage rises positively, carrying the saw cathode follower grid, cathode (V8204) and timing capacitor in the same direction. Thus, the positive voltage swing on the opposite side of the timing capacitor tends to prevent the grid side from swinging

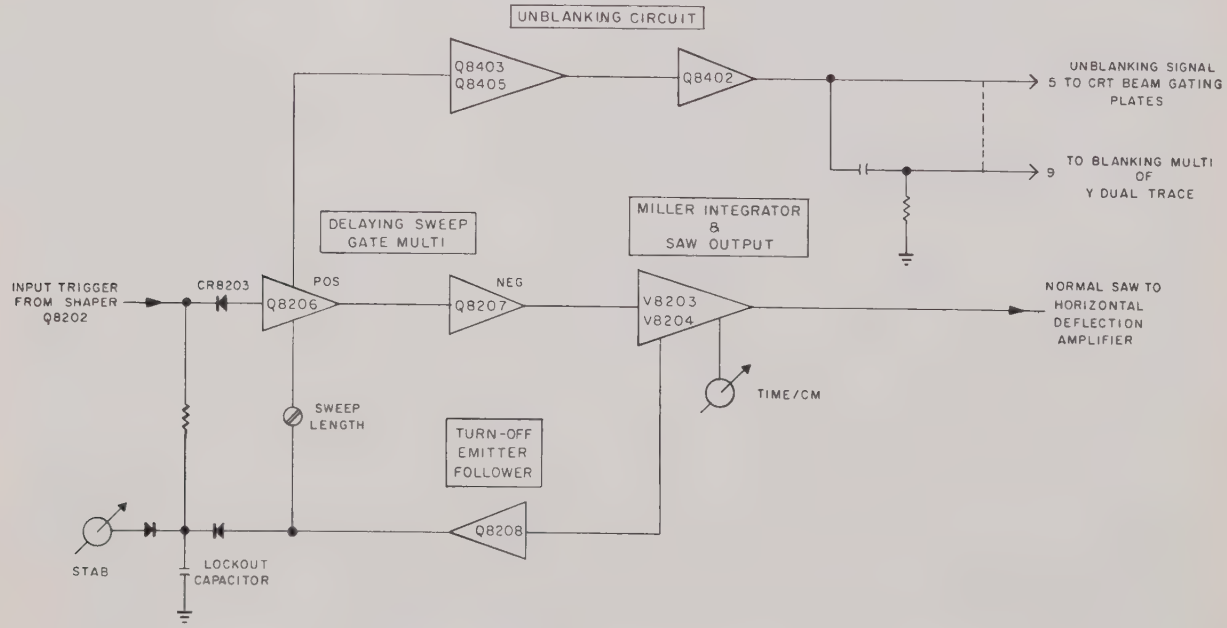


FIGURE 2-2. NORMAL SWEEP MODE, FUNCTIONAL BLOCK DIAGRAM

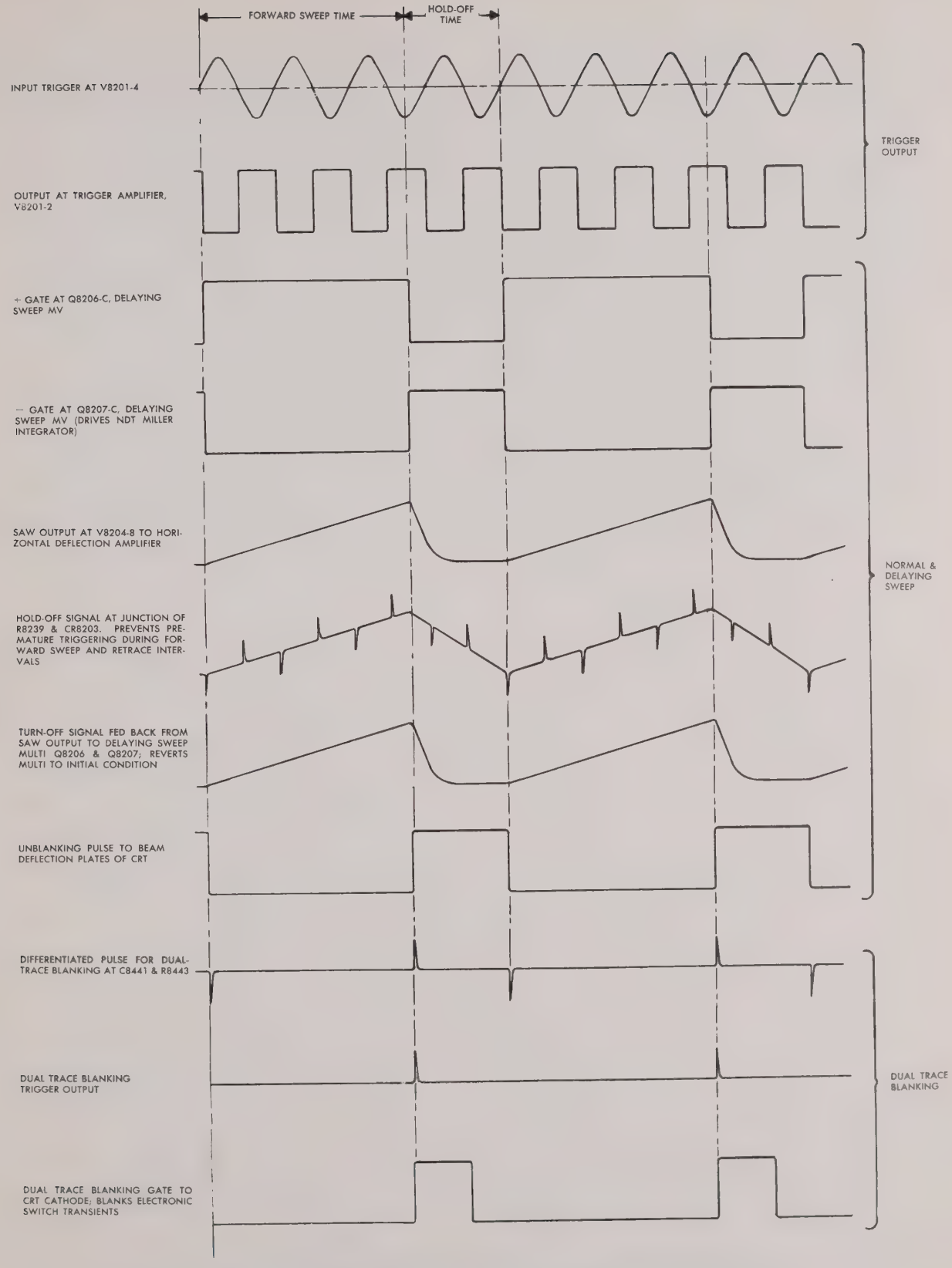

FORWARD SWEEP TIME
HOLD-OFF TIME
INPUT TRIGGER AT V8201-4
OUTPUT AT TRIGGER AMPLIFIER, V8201-2
TRIGGER OUTPUT
+ GATE AT Q8206-C, DELAYING SWEEP MV
— GATE AT Q8207-C, DELAYING SWEEP MV (DRIVES NDT MILLER INTEGRATOR)
SAW OUTPUT AT V8204-8 TO HORIZONTAL DEFLECTION AMPLIFIER
HOLD-OFF SIGNAL AT JUNCTION OF R8239 & CR8203. PREVENTS PREMATURE TRIGGERING DURING FORWARD SWEEP AND RETRACE INTERVALS
TURN-OFF SIGNAL FED BACK FROM SAW OUTPUT TO DELAYING SWEEP MULTI Q8206 & Q8207; REVERTS MULTI TO INITIAL CONDITION
NORMAL & DELAYING SWEEP
UNBLANKING PULSE TO BEAM DEFLECTION PLATES OF CRT
DIFFERENTIATED PULSE FOR DUAL-TRACE BLANKING AT C8441 & R8443
DUAL TRACE BLANKING TRIGGER OUTPUT
DUAL TRACE BLANKING
DUAL TRACE BLANKING GATE TO CRT CATHODE; BLANKS ELECTRONIC SWITCH TRANSIENTS

FIGURE 2-3. TIMING DIAGRAM FOR NORMAL SWEEP DISPLAY

negatively. It also increases the voltage to which the timing capacitor is trying to charge. The net result is to *straighten out* the charging curve (sweep voltage) by maintaining a constant current flow into the capacitor.

Since the grid of V8203 remains at a constant potential within a small fraction of a volt, the current through the charging resistor remains constant and the sweep timing capacitor thus charges at a constant rate. The resulting linear sawtooth waveform is applied to the horizontal deflection amplifier through output cathode follower, V8204.

c. Sweep Length

The sweep length, or the total duration of the sweep for any given sweep rate is determined by the setting of the SWEEP LENGTH adjustment, R8263. A portion of the positive sawtooth voltage is fed back to the turn-off emitter follower, Q8208, and the saw turn-off diode, CR8204. When the voltage from the SWEEP LENGTH potentiometer is properly set, diode CR8204 will conduct and apply a positive pulse to Q8206. At that moment, the delaying sweep gate multivibrator will revert rapidly to its original state with Q8206 conducting, and Q8207 at cutoff. The positive step from the collector of Q8207 returns the disconnect diodes, CR8216, CR8209 and CR8211, back to their conducting state, thus discharging the timing capacitors. The Miller circuit now returns to its quiescent level and is ready for the next trigger.

d. Lockout Circuit

The lockout circuit prevents the delaying sweep multivibrator from being triggered until after the Miller integrator circuit has stabilized in the quiescent condition after completion of the sweep retrace. This is accomplished by holding the cathode of the series triggering diode, CR8203, at a suitable positive voltage for a given period after the completion of the sweep.

During the forward-sweep interval, a portion of the positive sweep voltage is fed back to the base of the turn-off emitter follower, Q8208, which charges the lockout capacitor through coupling diode, CR8206. During the return-trace interval, diode CR8206 is cut off and the lockout capacitor is obliged to discharge through R8261. The turn-off emitter follower will not reset the delaying sweep gate multivibrator until the

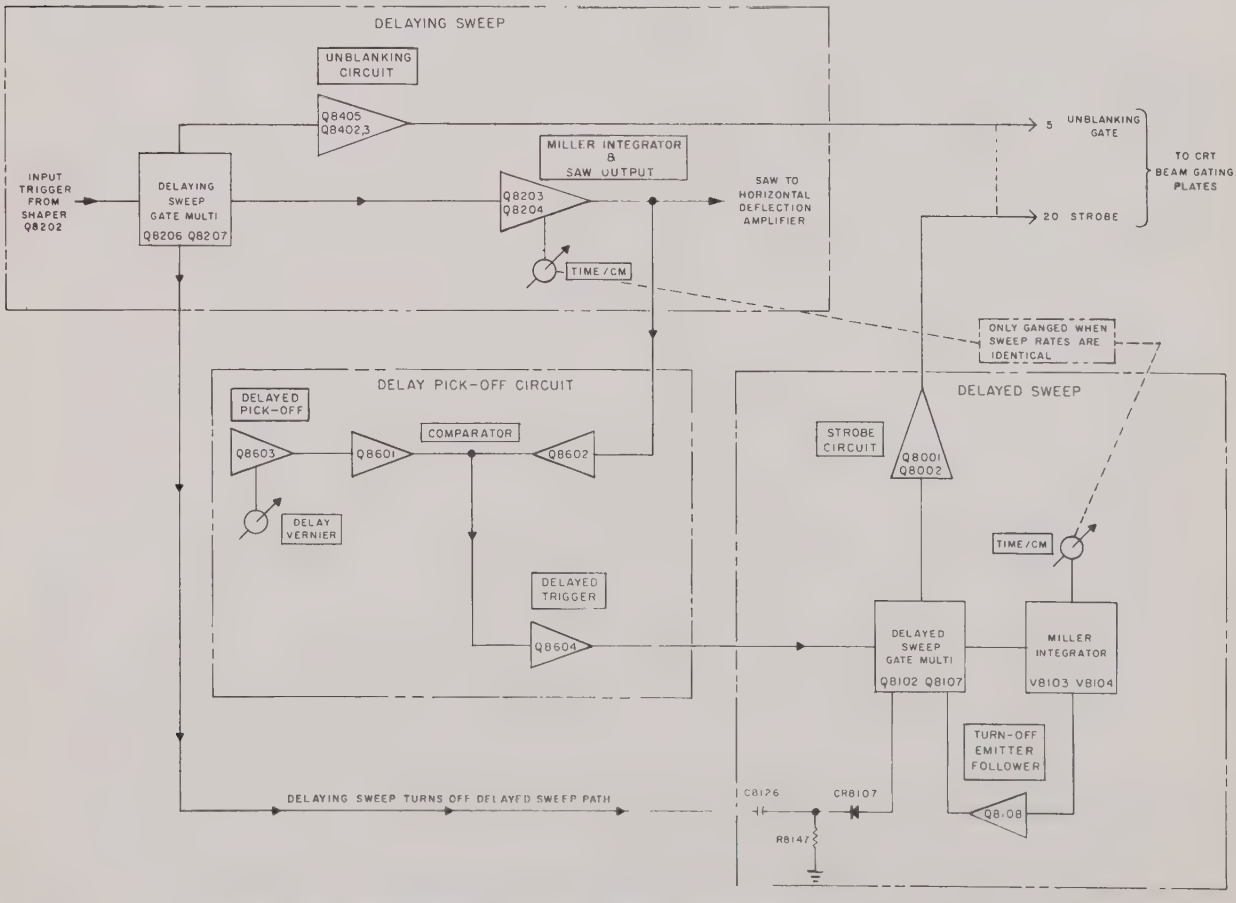


FIGURE 2-4. TRIGGERED STROBE MODE, FUNCTIONAL BLOCK DIAGRAM

appropriate lockout timing capacitor has been discharged. The value of this capacitor is chosen to give lockout beyond the time that the sweep has returned to rest at its initial starting point. The duration of the lockout interval is determined by the sweep-charging time constant. Consequently, the SWEEP RATE switch changes the amount of capacitance in the lockout circuit. This technique prevents additional triggers from energizing the sweep during its forward and retrace interval.

The front-panel screwdriver STAB control may be used to adjust the level of the lockout voltage that initiates Q8206, thereby improving count-down and lock-in of signals having repetition rate of 5 megacycles or greater. Also, this control may be used to optimize triggering under severe environmental conditions at or near the limits of the temperature range.

e. Unblanking Gate

The positive pulse developed at the collector of Q8206 of the delaying sweep gate multivibrator is applied to the base of the unblanking cascode amplifier, Q8405 and Q8403. This gate signal is coincident with the sweep time and is also available at a front panel connector labeled GATE OUT. The resulting negative pulse developed at the collector of Q8403 is applied to the CRT beam gating plates through emitter follower Q8402. This action renders the dis-

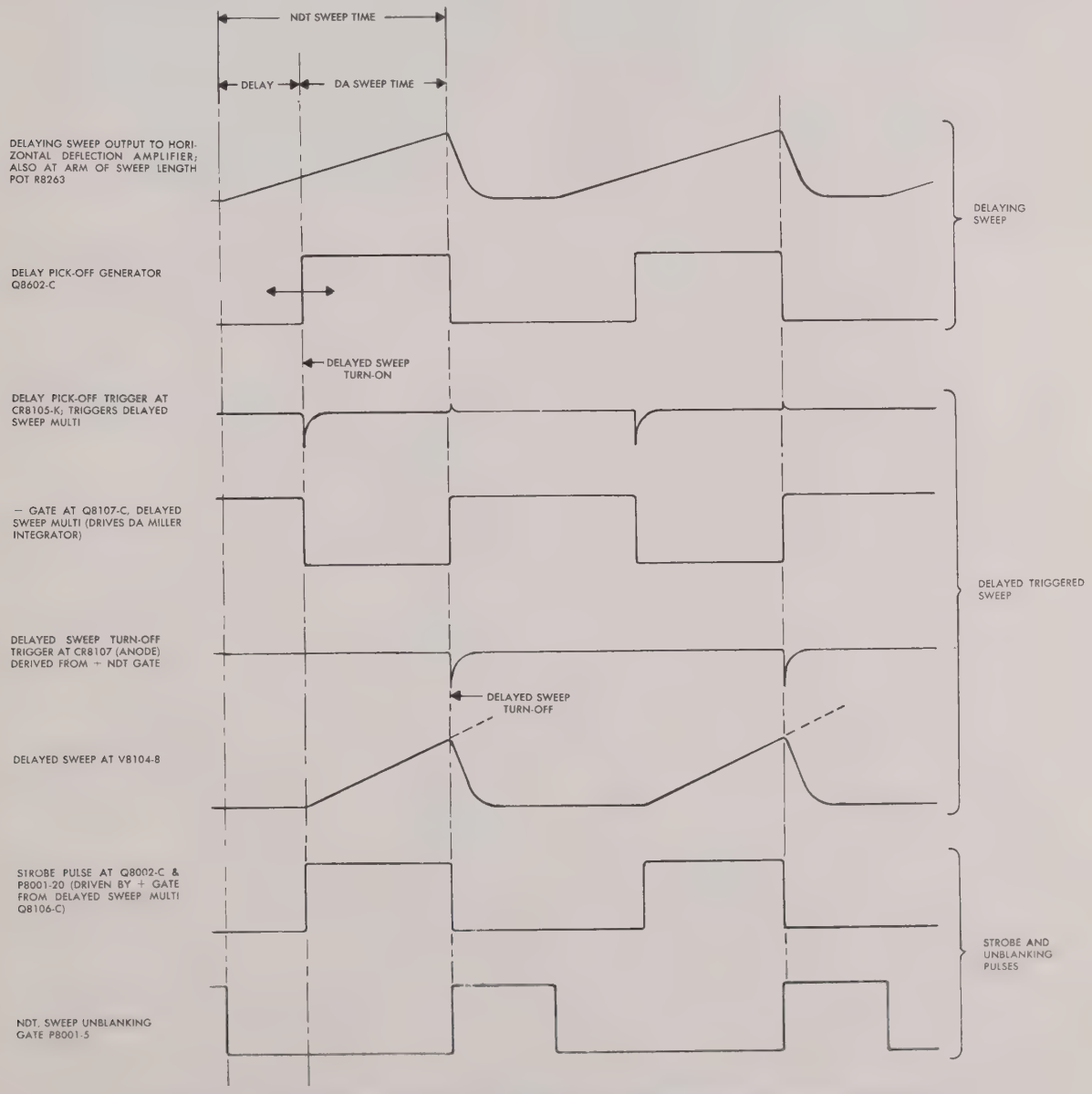

NDT SWEEP TIME
DELAY
DA SWEEP TIME
DELAYING SWEEP OUTPUT TO HORIZONTAL DEFLECTION AMPLIFIER; ALSO AT ARM OF SWEEP LENGTH POT R8263
DELAYING SWEEP
DELAY PICK-OFF GENERATOR Q8602-C
DELAYED SWEEP TURN-ON
DELAY PICK-OFF TRIGGER AT CR8105-K; TRIGGERS DELAYED SWEEP MULTI
— GATE AT Q8107-C, DELAYED SWEEP MULTI (DRIVES DA MILLER INTEGRATOR)
DELAYED TRIGGERED SWEEP
DELAYED SWEEP TURN-OFF TRIGGER AT CR8107 (ANODE) DERIVED FROM + NDT GATE
DELAYED SWEEP TURN-OFF
DELAYED SWEEP AT V8104-8
STROBE PULSE AT Q8002-C & P8001-20 (DRIVEN BY + GATE FROM DELAYED SWEEP MULTI Q8106-C)
STROBE AND UNBLANKING PULSES
NDT, SWEEP UNBLANKING GATE P8001-5

FIGURE 2-5. SIMPLIFIED TIMING DIAGRAM FOR TRIGGERED-STROBE DISPLAY

play visible only during the forward-sweep interval. Hence, the CRT screen is blank during the retrace and lock-out interval. Transistor, Q8401, serves as an emitter follower voltage source for the collector of Q8402, and it also prevents the collector voltage of Q8403 from exceeding 125 volts.

A portion of the negative pulse from the unblanking emitter follower Q8402 is applied to a differentiating network, C8441 and R8443. The output from this network provides the proper trigger to the blanking multivibrator of the Dual-Trace Plug-in.

These Delaying Sweep Time Base Plug-in units may be used in the X or Y cavity of the Main Frame. Only the X cavity permits retrace beam blanking signals to be coupled to the cathode-ray tube. Therefore, sweep operation in the vertical direction will show the sweep retrace.

2-4. CIRCUIT DESCRIPTION OF TRIGGERED-STROBE MODE (Figures 2-4 and 2-5)

When the DISPLAY LOGIC switch is set to Triggered STROBE, the delay pick-off, the delayed sweep, and strobe circuits are activated.

In the "triggered" mode, the delaying sweep receives the external trigger signal while the delayed sweep receives its trigger signal later from the delaying sweep. The triggering signal for the delayed sweep in this mode is derived from the delaying sweep at the exact instant this sweep reaches a level determined by the adjustment of the delay pick-off circuit. This mode from now on will be referred to as the delayed-triggered mode.

The Normal and Delaying Sweep circuit functions as previously described. Major difference between the triggered strobe and the Normal mode circuits may be seen by comparison of the block diagram.

Referring to Figure 2-4, the saw from the Delaying Sweep circuit is applied to the horizontal deflection amplifier and to the input of the delay pick-off comparator circuit, Q8501 and Q8602.

This circuit is a differential amplifier which compares the voltage level of the input delaying sweep

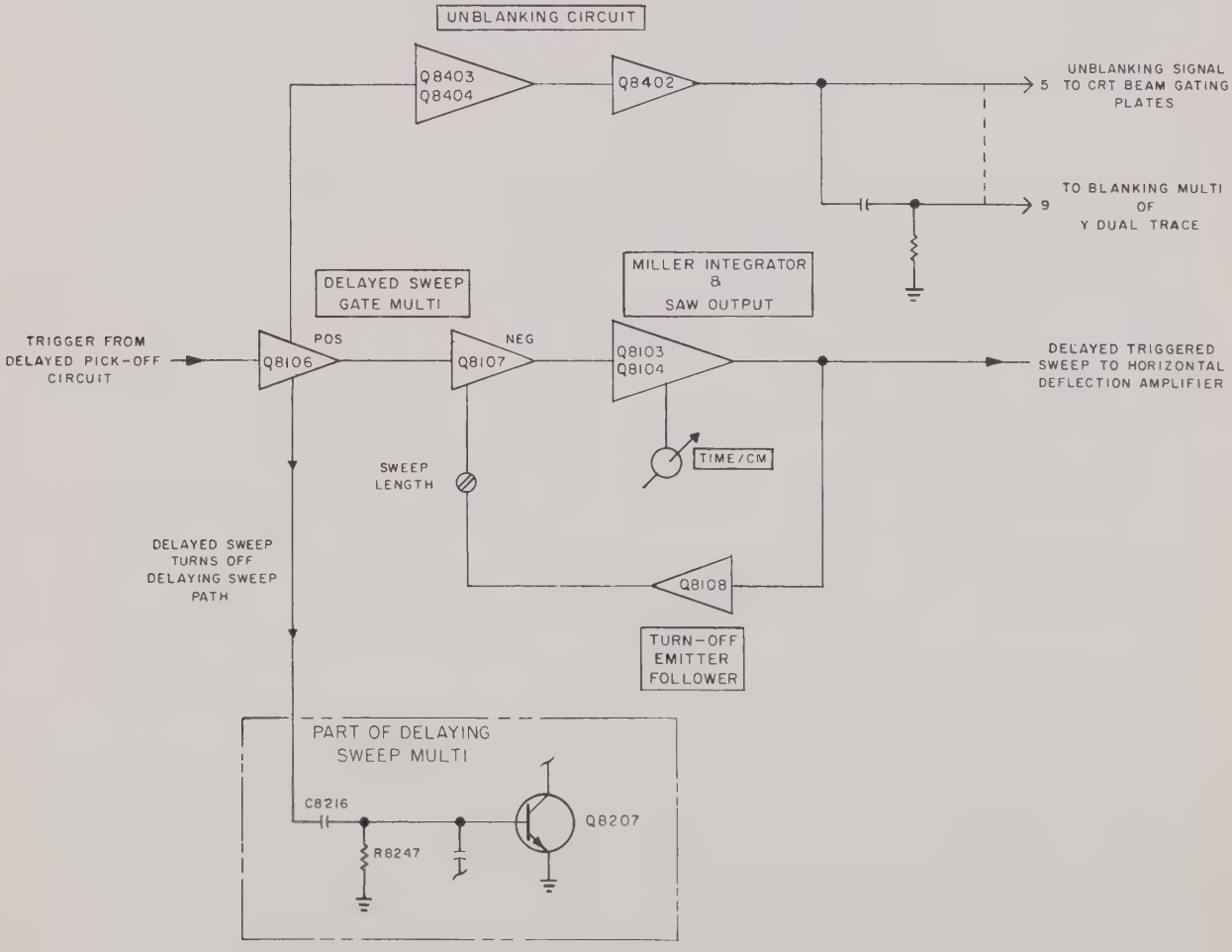


FIGURE 2-6. DELAYED-TRIGGERED MODE, FUNCTIONAL BLOCK DIAGRAM

against a fixed voltage obtained from the DELAY VERNIER control. When the voltage level of the delaying sawtooth waveform reaches a certain level, as determined by the setting of the DELAY VERNIER control, the output of the comparator circuit is applied to a delayed trigger amplifier, Q8604, which drives coupling transformer T8601. The negative pulse from the secondary of this transformer is through series coupling diode, CR8105, to trigger the delayed sweep gate multivibrator, Q8106 and Q8107.

The positive gate developed at the collector of Q8106 is coincident with the *delayed* TIME/CM control setting and is applied to the strobe circuit, Q8001 and Q8002. The positive strobe signal is applied to one of the beam-gating electrodes of the CRT. The delaying sweep unblanking gate is applied to the other beam-gating electrode.

The cathode-ray beam is kept turned off when a sweep is not moving the beam across the screen. When a sweep is in progress, the beam is turned on by an unblanking signal that lasts as long as the sweep and then turns the beam back off after the sweep is completed. When both the delaying and delayed sweeps are running, each produces its own unblanking signal. The delayed sweep unblanking pulse (strobe) makes a brighter trace than the delaying sweep pulse.

The difference in brightness for the two pulses is useful for finding out where to set the delay controls to display the part of the signal you wish to examine. Detailed instruction on setting up the strobe is found in Section 2, Operation.

The delaying sweep is automatically turned off when the delayed sweep has terminated. This action is developed as follows: the positive gate produced at

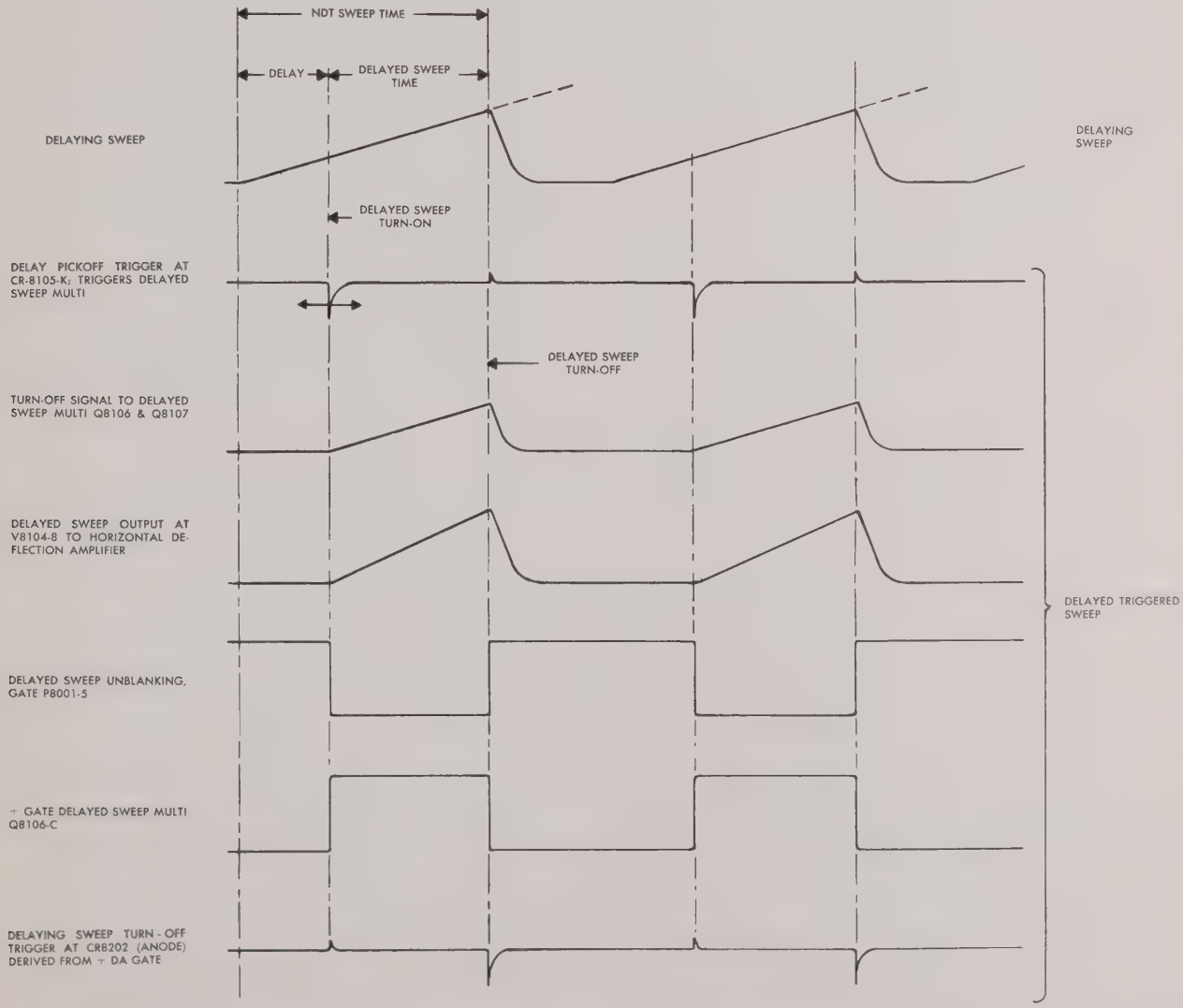

NDT SWEEP TIME
DELAY
DELAYED SWEEP TIME
DELAYING SWEEP
DELAYING SWEEP
DELAYED SWEEP TURN-ON
DELAY PICKOFF TRIGGER AT CR-8105-K; TRIGGERS DELAYED SWEEP MULTI
DELAYED SWEEP TURN-OFF
TURN-OFF SIGNAL TO DELAYED SWEEP MULTI Q8106 & Q8107
DELAYED SWEEP OUTPUT AT V8104-8 TO HORIZONTAL DEFLECTION AMPLIFIER
DELAYED TRIGGERED SWEEP
DELAYED SWEEP UNBLANKING, GATE P8001-5
+ GATE DELAYED SWEEP MULTI Q8106-C
DELAYING SWEEP TURN-OFF TRIGGER AT CR8202 (ANODE) DERIVED FROM + DA GATE

FIGURE 2-7. SIMPLIFIED TIMING DIAGRAM FOR DELAYED-TRIGGERED DISPLAY

the collector of the delayed sweep multivibrator (Q8106), is applied to a differentiating network consisting of R8247 and C8216. Series coupling diode, CR8202, is biased to permit only the trailing edge of the delayed sweep gate to trigger the delaying sweep multivibrator and subsequently terminating the NDT sweep. This prevents brightening of the sweep retrace in the STROBE position.

2-5. CIRCUIT DESCRIPTION OF DELAYED-TRIGGERED MODE (Figures 2-6 and 2-7)

When the DISPLAY LOGIC switch is set to Triggered DELAYED, the delayed sweep and not the delaying sweep is applied to the horizontal deflection amplifier. The brightened sector of the display in the STROBE position will now be expanded to full screen in the DELAYED position.

The delayed-triggered sweep circuit is similar in operation to the triggered-strobe mode described earlier, except that the strobe circuit is now inactivated.

Automatic provision is made for shut-off of the delaying sweep when the delayed sweep terminates. This technique permits maximum duty cycle performance in the Delayed Mode.

2-6. CIRCUIT DESCRIPTION OF ARMED-STROBE MODE (Figures 2-8 and 2-9)

When the DISPLAY LOGIC switch is set to Armed STROBE, the delay pick-off circuit, the arming multivibrator, the delayed sweep, and strobe circuits are activated.

In the "armed" mode, the delayed sweep is triggered by a selected external triggering signal. All triggering signals are blocked by the armed lockout diode until a signal from the delay pick-off circuit triggers the arming multivibrator. This action unlocks the diode and opens the trigger circuit to the delayed sweep, making it possible for the next appropriate triggering signal to initiate the delayed sweep. In this mode of operation, the delayed sweep does not start precisely at the delay time indicated by the DELAY VERNIER and NDT TIME/CM control setting, but instead is initiated by the next suitable triggering following the indicated delay interval. This mode from now on will be referred to as the Delayed-Armed mode of sweep operation.

The armed lockout diode, CR8102, is now forward-biased by the voltage applied to it from the collector of Q8103, thus opening the triggering circuit to the delayed sweep gate generator, Q8106 and Q8107.

The SWP READY lamp on the front panel goes on when the delay time has elapsed to indicate that the delayed sweep circuit is ready to be triggered. When the delayed sweep is triggered, the SWP READY lamp then goes out. If the delayed-armed sweep is triggered immediately at the completion of the delay time, the SWP READY lamp may not appear to go on.

The next suitable trigger from the DA trigger is applied to the delayed sweep multivibrator which immediately changes states (it flips). Q8106 forms a positive gate while Q8107 forms a negative gate during the "delayed" sweep forward interval.

In the quiescent state of the armed multivibrator, Q8103 is at cutoff and Q8104 is conducting. The armed lockout diode CR8102 is thus back-biased by the voltage applied to it from the collector of Q8103.

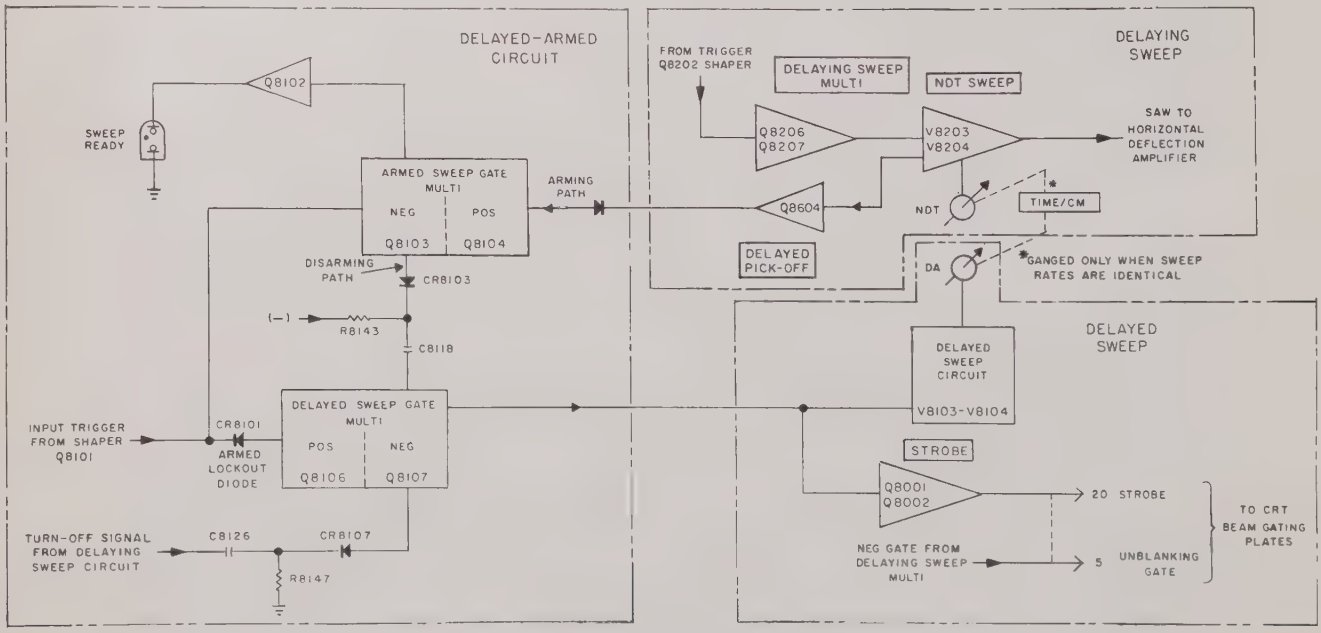


FIGURE 2-8. ARMED STROBE MODE, FUNCTIONAL BLOCK DIAGRAM

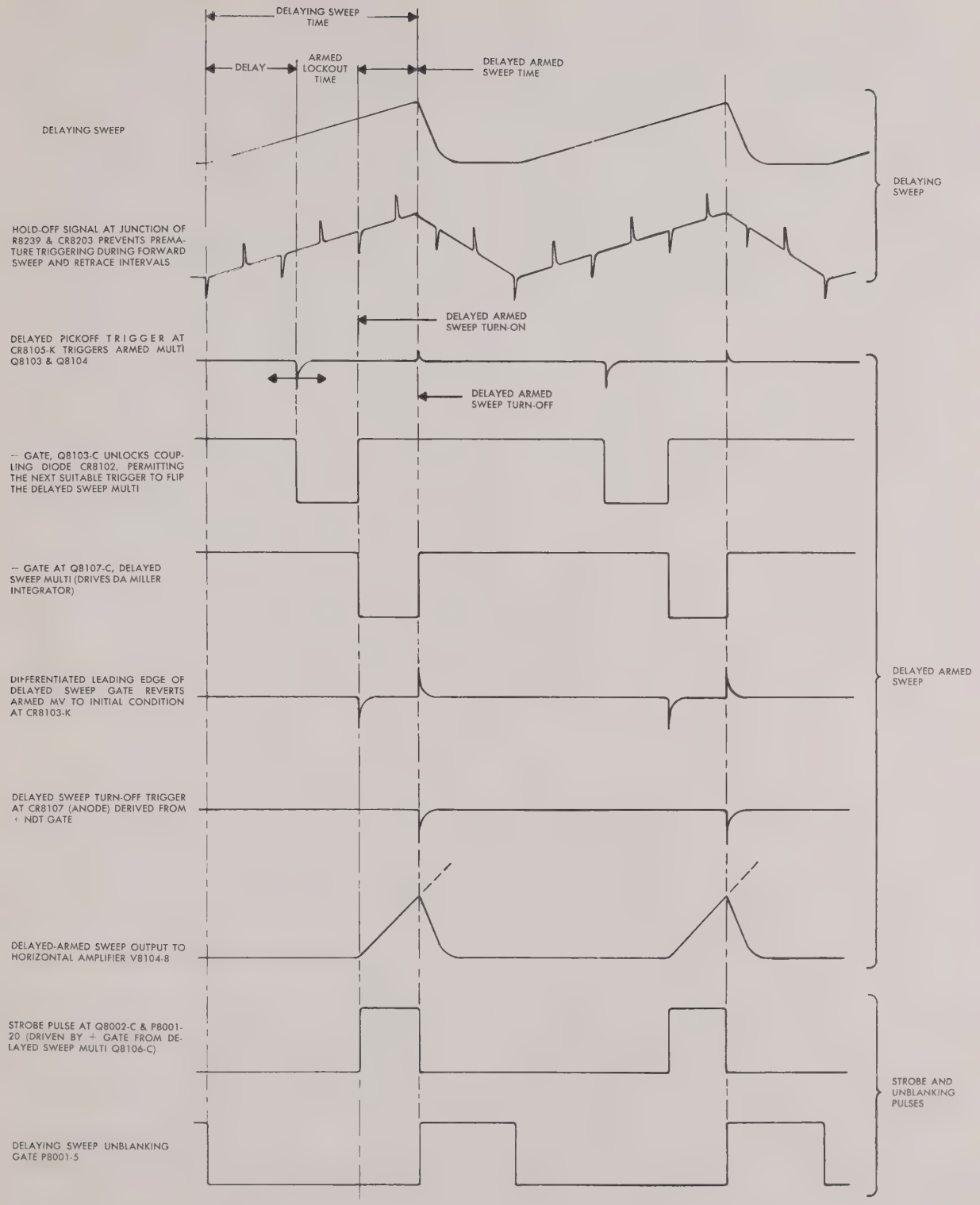

DELAYING SWEEP TIME
DELAY
ARMED LOCKOUT TIME
DELAYED ARMED SWEEP TIME
DELAYING SWEEP
DELAYING SWEEP
HOLD-OFF SIGNAL AT JUNCTION OF R8239 & CR8203 PREVENTS PREMATURE TRIGGERING DURING FORWARD SWEEP AND RETRACE INTERVALS
DELAYED ARMED SWEEP TURN-ON
DELAYED PICKOFF TRIGGER AT CR8105-K TRIGGERS ARMED MULTI Q8103 & Q8104
DELAYED ARMED SWEEP TURN-OFF
– GATE, Q8103-C UNLOCKS COUPLING DIODE CR8102, PERMITTING THE NEXT SUITABLE TRIGGER TO FLIP THE DELAYED SWEEP MULTI
– GATE AT Q8107-C, DELAYED SWEEP MULTI (DRIVES DA MILLER INTEGRATOR)
DIFFERENTIATED LEADING EDGE OF DELAYED SWEEP GATE REVERTS ARMED MV TO INITIAL CONDITION AT CR8103-K
DELAYED ARMED SWEEP
DELAYED SWEEP TURN-OFF TRIGGER AT CR8107 (ANODE) DERIVED FROM + NDT GATE
DELAYED-ARMED SWEEP OUTPUT TO HORIZONTAL AMPLIFIER V8104-8
STROBE PULSE AT Q8002-C & P8001-20 (DRIVEN BY + GATE FROM DELAYED SWEEP MULTI Q8106-C)
STROBE AND UNBLANKING PULSES
DELAYING SWEEP UNBLANKING GATE P8001-5

FIGURE 2-9. SIMPLIFIED TIMING DIAGRAM FOR DELAYED-ARMED STROBE DISPLAY

FIGURE 2-9. SIMPLIFIED TIMING DIAGRAM FOR DELAYED-ARMED STROBE DISPLAY

This action locks out incoming triggering signals to the delayed sweep gate multivibrator, thereby inactivating the delayed sweep.

The arming signal from the delayed pick-off circuit is coupled from transformer, T8601, through diode, CR8104, to the base of transistor Q8104. The bistable armed multivibrator changes states: Q8104 is at cutoff and Q8103 is conducting.

The leading edge of the negative gate at the collector of Q8107 is differentiated by C8118 and R8143 and applied to the armed multivibrator through diode, CR8103. This disarming trigger reverts the armed multivibrator to its initial condition.

After the bistable delayed sweep gate multivibrator has been triggered, it will revert to its original state as determined by the setting of the SWP LENGTH adjustment, R8159. The delayed sweep will remain inactivated until the armed multivibrator is rearmed by a signal from the delayed pick-off circuit.

The development of the strobe and unblanking pulses are identical to that described for the triggered-delayed mode. Automatic provision is made for turning off the NDT sweep when the DA sweep has terminated. This prevents brightening of the sweep retrace in the strobe position.

2-7. CIRCUIT DESCRIPTION OF DELAYED-ARMED MODE (Figures 2-10 and 2-11)

When the DISPLAY LOGIC switch is set to Armed DELAYED, the delayed sweep is applied to horizontal deflection plates.

The delayed-armed sweep circuit is similar in operation to the armed strobe mode described earlier except that the strobe circuit is now inactivated.

2-8. HORIZONTAL DEFLECTION CIRCUIT DESCRIPTION (Figure 2-12)

The output from the NDT or DA sweep circuits is applied to the base of emitter follower, Q8301.

The POSITION control supplies a manually adjustable dc voltage to the base of Q8301 for positioning the display on the screen. For the Types 746/766 Series, a PATTERN POSITIONING control is mounted on the front panel of the Main Frame, and is electrically coupled to the POSITION control of both the X and Y Plug-ins. This feature permits positioning the entire display in the horizontal and vertical directions on the screen via use of the single joy-stick control.

The output from the emitter of Q8301 is applied directly to the common emitter follower, Q8302 and Q8303, which converts the single-end input to a push-pull output. The signal now progresses through an emitter follower, Q8306 and Q8305, and is then applied to the output amplifier, Q8307 to Q8311. In this output amplifier stage, the signal develops the necessary power for driving the horizontal deflection plates.

Five-times magnification of the sweep is accomplished by reducing the common emitter feedback of Q8302 and Q8303, by a factor of 5 when the X5 control is pulled out. Consequently, the sweep rate ob-

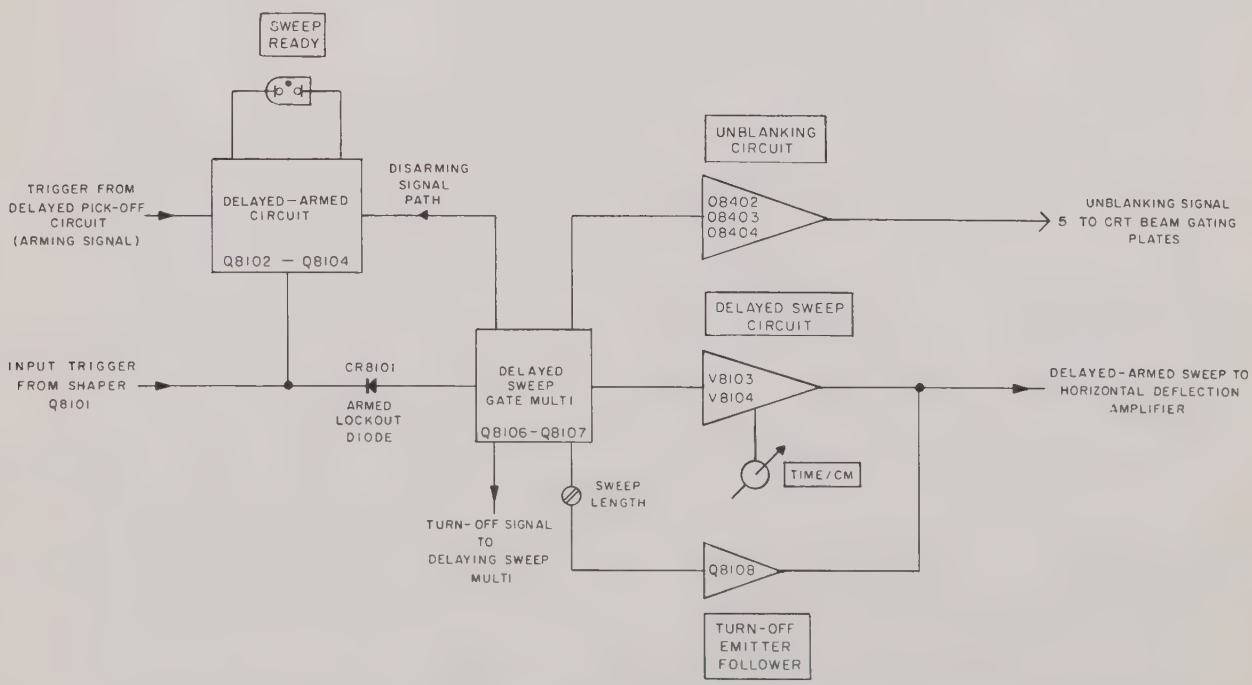


FIGURE 2-10. DELAYED-ARMED MODE, FUNCTIONAL BLOCK DIAGRAM

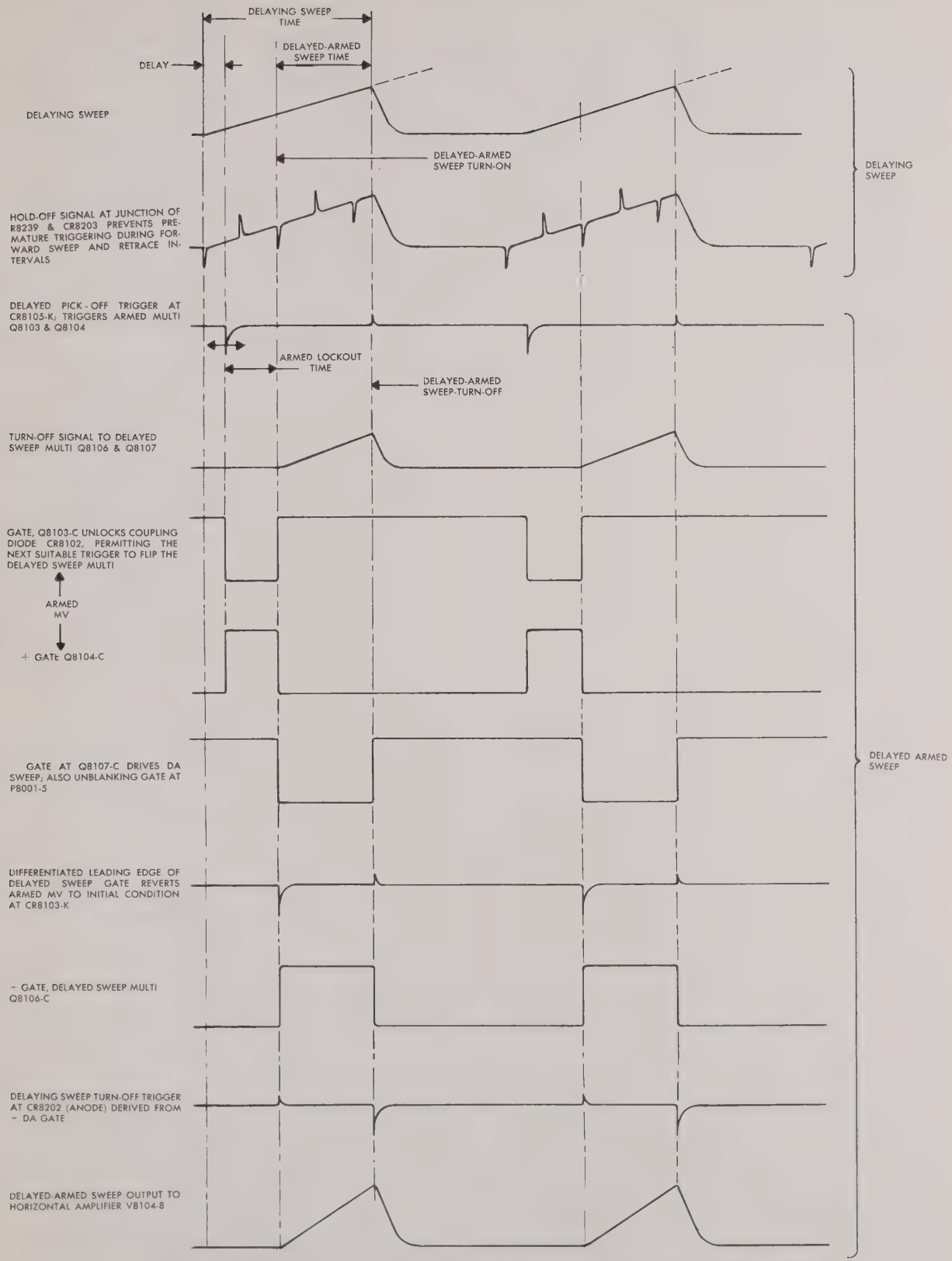

DELAYING SWEEP TIME
DELAYED-ARMED SWEEP TIME
DELAY
DELAYING SWEEP
DELAYED-ARMED SWEEP TURN-ON
DELAYING SWEEP
HOLD-OFF SIGNAL AT JUNCTION OF R8239 & CR8203 PREVENTS PREMATURE TRIGGERING DURING FORWARD SWEEP AND RETRACE INTERVALS
DELAYED PICK-OFF TRIGGER AT CR8105-K; TRIGGERS ARMED MULTI Q8103 & Q8104
ARMED LOCKOUT TIME
DELAYED-ARMED SWEEP-TURN-OFF
TURN-OFF SIGNAL TO DELAYED SWEEP MULTI Q8106 & Q8107
GATE, Q8103-C UNLOCKS COUPLING DIODE CR8102, PERMITTING THE NEXT SUITABLE TRIGGER TO FLIP THE DELAYED SWEEP MULTI
ARMED MV
+ GATE Q8104-C
GATE AT Q8107-C DRIVES DA SWEEP; ALSO UNBLANKING GATE AT P8001-5
DELAYED ARMED SWEEP
DIFFERENTIATED LEADING EDGE OF DELAYED SWEEP GATE REVERTS ARMED MV TO INITIAL CONDITION AT CR8103-K
+ GATE, DELAYED SWEEP MULTI Q8106-C
DELAYING SWEEP TURN-OFF TRIGGER AT CR8202 (ANODE) DERIVED FROM + DA GATE
DELAYED-ARMED SWEEP OUTPUT TO HORIZONTAL AMPLIFIER V8104-8

FIGURE 2-11. SIMPLIFIED TIMING DIAGRAM FOR DELAYED-ARMED DISPLAY

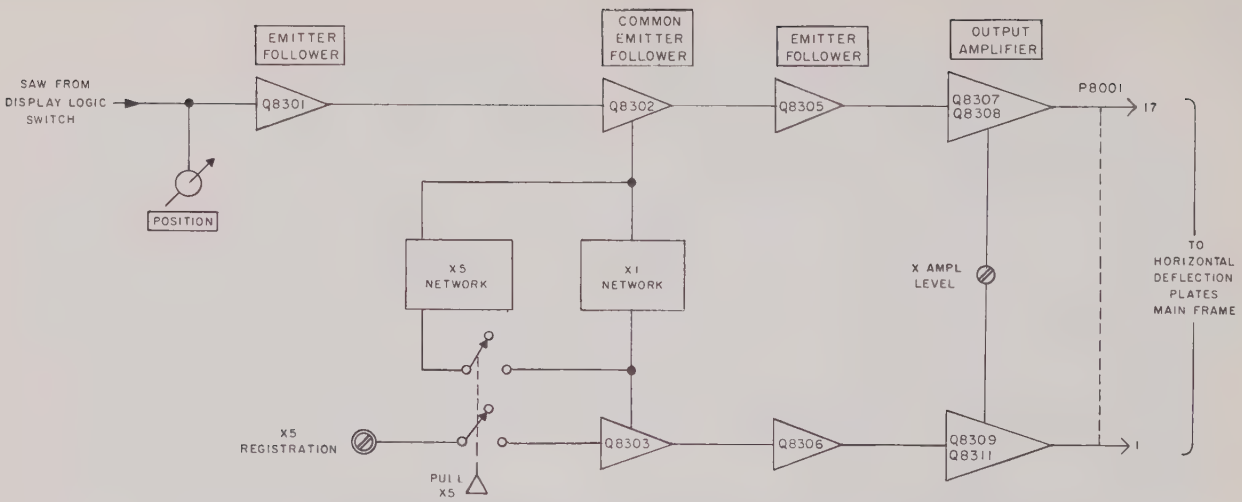


FIGURE 2-12. HORIZONTAL DEFLECTION AMPLIFIER, FUNCTIONAL BLOCK DIAGRAM

served on the screen of the cathode-ray tube is effectively magnified five times. The X5 REGISTRATION service adjustment, R8311, is provided to adjust the voltage level at the base of Q8303 so that the center of the trace is not depositioned from CRT screen center, when the PULL X5 switch is activated.

2-9. LOCATION OF REPLACEABLE COMPONENTS

Identifications of all replaceable components, including those mounted on assembly boards are shown in photographs in Section 4.

Since the production of this instrument, some of the parts may have been superseded by improved components. In such cases, the part numbers of these new components will not be listed in your Parts List. However, if you order a part from Du Mont, and it has been superseded by an improved component, the new part will be shipped in place of the part ordered. Your local Du Mont representative has knowledge of these changes and may call you if a change in your purchase order is necessary.

It is the aim of the Du Mont organization to make available the most reliable commercial oscilloscopes within the state of the art and to provide services which will help the user to rapidly restore any Du Mont equipment to its specified performance. Your local Du Mont field representative maintains a limited number of spare parts, or the factory may be asked to air-ship replacement parts.

2-10. SERVICING HINTS

General maintenance and trouble-shooting information is given in the Type 745/765 Series Oscilloscope Instruction Manual. In the following discussion, it is assumed that you have already read that information and have definitely isolated a trouble in the Time Base Plug-in unit.

In trouble shooting a Plug-in Unit, it becomes necessary to determine if the defect is in the plug-in or in the Main Frame of the oscilloscope. The quickest and easiest way of isolating the trouble is to substitute another plug-in unit and determine if the same trouble persists. If the trouble continues after substitution, it can be safely assumed that the defect is in the Main Frame.

There is no simple way of locating troubles. An understanding of the functions of the circuits is the best help. With an understanding of the circuit operation, it will be possible to make a good guess at the general source of troubles from the symptoms. As an aid in trouble-shooting this unit, refer to the functional block and timing diagrams in this section and to the schematics.

To keep electronic units operating at top performance, it is desirable to check the equipment at regular intervals. The period between checks will depend on the installation and the conditions of operation. In general, portable units moved about constantly, or units operated in very hot, moist, or dirty areas will require more frequent service.

For these regular checks, clean all dust and dirt from the unit using a light air blast or soft brush.

In the event of improper performance of the Plug-in Unit, the following suggestions are recommended:

1. The Du Mont Type 4294 Extension Cable for remote operation of the plug-in from the oscilloscope, is available as an accessory. This plug-in extender will be helpful for routine maintenance and recalibration. Its use is mandatory for the Type 747/767 Rack-mounted Oscilloscopes which are not provided with side access to the adjustments.

2. A Du Mont Type 766 Test Oscilloscope is recommended for localizing troubles, especially when servicing a Type 74-11/74-13 inserted in a Type 747/767 Oscilloscope. To check waveforms, use a high-impedance probe. The Du Mont Type 4290 or 4298 Attenuator Probe is recommended for this application.

3. Maintain a high quality of workmanship. Use a clean bench and soldering iron; keep solder joints smooth and bright; do not overheat any component

while soldering. Use heat sinks when soldering semiconductors. The use of a 30-watt iron such as a Hexacon Type 26S is recommended. When using accessory probes or adapters, be sure the trouble is not originating in the accessory before suspecting the oscilloscope itself.

2-11. GAINING ACCESS TO CHASSIS

Since the Plug-in is not contained in its own dust cover, most of the components are readily accessible when the plug-in is removed from the Main Frame. To gain access to the chassis, simply unscrew the knurled thumbscrew at center bottom of unit and pull it free of the Main Frame.

2-12. TEST EQUIPMENT REQUIRED FOR SERVICE ADJUSTMENTS

a. Introduction

The adjustments outlined in the following paragraphs are based on the test procedure followed at the factory, and apply to both the Type 74-11 and Type 74-13 Modules unless otherwise specified. All adjustments should be made at mid-line voltage, 115V/230V ±2%.

To set up the Time Base Unit for calibration, insert an amplifier plug-in and the Time Base plug-in into the Main Frame. The amplifier plug-in module and the Main Frame must be fully tested and certified units.

b. Test Equipment Required (Equivalent may be substituted)

Type	Description
Differential Voltmeter	John Fluke Model 825A; 0.1 to 500 volts, 0.1% accuracy
Time-Mark Generator	Tektronix Type 180A
Attenuator Probe	Du Mont Type 4290 or 4298; 10:1 and terminated in BNC type connector; 10 megohms, 10 pf input
Square Wave Generator	Tektronix Type 105A and 93-ohm Cable Termination Type B93R
Volt-ohmmeter	Simpson Model 260, 20,000 ohms/volt
Alignment Tool	Insulated screwdriver

Turn on the power and allow 30 to 60 minutes of warm-up time before making any adjustments. Preset the front-panel controls as indicated.

WARNING

WHEN THE PANELS OR PLUG-INS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON.

The lower-voltage busses are potentially more dangerous than the cathode-ray tube potential because of the high-current capabilities and large filter capacitors employed in these supplies. When you reach into the instrument with one hand while it is turned on, do not grasp the metal frame with the other hand. If possible, stand on an insulated floor and use insulated tools. It is advisable to ground the third lead in the power cord whenever the instrument is in use.

Control	Setting
TRIG LEVEL	ZERO
DISPLAY LOGIC	NORMAL
TRIGGER SOURCE	EXT
TRIGGER COUPLING	DC
TRIGGER SLOPE	+
TIME/CM (NDT & DA)	5 mSEC
TIME/CM Vernier	CAL (fully cw)
VOLTS/DIV (Y Plug-in)	OFF
PULL X5	Pushed in (X1)
POSITION	Centered

2-13. DC ADJUSTMENTS

a. Stability Adjustment (R8268)

1. Adjust front-panel STAB control until a trace just appears (recurrent sweep).

2. Record the voltage at the cathode (K) of the trigger coupling diode CR8203.

3. Adjust the STAB control to increase the voltage to 0.2 volt more positive than the recorded value. (The trace on the screen should be just passed the threshold of vanishing.)

NOTE: Make sure the triggering channel is shut off during the adjustment.

b. NDT & DA Trig Sense Adjustment (R8229 and R8118)

1. Set the NDT and DA front-panel Trig LEVEL controls to Zero.

2. Temporarily connect a 680-ohm resistor from the junction of Z8201 and R8231 to the junction of tunnel diode CR8201 and R8228.

3. Adjust TRIG SENS potentiometer, R8229, until a trace is displayed on the screen. It may be necessary to manipulate the NDT Trig LEVEL control in order to produce the trace. This indicates that tunnel diode CR8201 is now free-running.

4. Back off TRIG SENS (R8229) setting until the trace disappears.

5. Again manipulate the NDT Trig LEVEL control to see whether or not the trace can be brought back on the screen. If the trace appears, readjust TRIG SENS potentiometer until the trace vanishes.

NOTE: Make sure that the tunnel diode is not free-running by turning the NDT Trig LEVEL control slowly back and forth several times.

6. Set DISPLAY LOGIC switch to DELAYED ARMED and the NDT TRIGGER SOURCE switch to LINE. Remove the 680-ohm resistor.

7. Temporarily connect a 680-ohm resistor from the junction of Z8101 and R8119 to the junction of tunnel diode CR8101 and R8117.

8. Repeat steps 2 through 5 using the DA controls and TRIG SENS potentiometer R8118.

9. Remove the 680-ohm resistor at the conclusion of the test.

c. Slow Sweep and X5 Calibration (R8263, R8159, R8311)

1. Preset front-panel controls as indicated:

Control	Setting
DISPLAY LOGIC	NORMAL
TRIGGER SOURCE	LINE
TRIGGER SLOPE	+
VOLTS/DIV (Y Plug-in)	CAL

2. Adjust SWP CAL front-panel screwdriver control until 3 cycles of the calibrator signal appears precisely in 10 centimeters.

3. Adjust the NDT SWEEP LENGTH potentiometer, R8263, until the display occupies 11 centimeters.

NOTE: Make certain that the UNCAL lamp is *off* during these adjustments.

4. Position the pattern so that the leading edge of one of the calibrator pulses is coincident with the vertical center line of the scale.

5. Pull out the X5 knob (concentric with the DISPLAY LOGIC knob).

6. Adjust the X5 REGISTRATION potentiometer, R8311, until the leading edge of the same pulse (see step 4) is again coincident with the vertical center line of the scale (within $\pm 1/2$ cm).

7. Push in the X5 knob.

8. Set DISPLAY LOGIC switch to DELAYED TRIGGERED and check calibration of the Delayed Sweep. (It should be identical to that in step 2.)

9. Adjust the DA SWEEP LENGTH potentiometer R8159 until the display occupies 11 centimeters.

d. Strobe Intensity Adjustment (R8012)

1. Set DISPLAY LOGIC switch to TRIGGERED STROBE and vary DELAY VERNIER control until the strobed section of the display starts at the vertical center line on the graticule.

2. Unclutch the outer knob on the TIME/CM switch and reduce the strobe length to approximately 1 centimeter by turning this knob clockwise.

3. Adjust the STROBE potentiometer, R8012, until a distinct contrast is produced.

e. X Amplifier High-Frequency Adjustments (C8303, C8306, C8309, C8137 and C8317)

1. Replace the Plug-in Amplifier in the Y cavity with a tested Time Base Plug-in Unit. This unit is then set up to obtain a vertical sweep.

NOTE: Unless otherwise noted, the test procedure for the balance of this setup pertains to the Time Base Unit inserted in the X cavity.

2. Set DISPLAY LOGIC switch to NORMAL.

3. Temporarily ground the collector of the delaying sweep unblanking amplifier, Q8405.

4. Apply a 100 Kc square wave signal from the Tektronix Type 105A Generator through a properly terminated cable to the junction of R8284 and R8623; (NDT sweep input to the horizontal deflection amplifier).

5. Adjust amplitude of the square wave pattern for 2 centimeters peak-to-peak about the scale center. In other words, 1 centimeter to the left and 1 centimeter to the right of the scale center line.

6. Adjust trimmer C8606 for a flat-top display.

7. Set the Square Wave Generator to 1 Mc and adjust oscilloscope controls for a 2-cycle pattern on the screen.

8. Center the pattern and adjust its amplitude the same way as was done in step 5.

9. Adjust trimmers C8309 and C8317 until best flat-top and rise time is achieved.

10. Pull out the X5 control and reduce square wave amplitude to give previous display.

11. Adjust trimmer C8303 for optimum flat-top display.

12. Repeat steps 9, 10, and 11 for optimum square-wave response.

13. Disconnect the ground strap from Q8405 used in step 3.

14. Set DISPLAY LOGIC switch to DELAYED TRIGGERED.

15. Temporarily ground the collector of the delayed sweep unblanking amplifier, Q8404.

16. Apply a 100 Kc square wave signal from the Tektronix Type 105A Generator through a properly terminated cable to the junction of R8181 and R8182 (DA sweep input to the horizontal deflection amplifier).

17. Adjust amplitude of square wave pattern for 2 centimeters peak-to-peak about the scale center (same as in step 5).

18. Adjust trimmer C8137 for a flat-top display.

NOTE: Do not remove the Time Base unit from the Y cavity yet. It is used for the test setup in the next paragraph.

f. Strobe Pattern Compensation Adjustment (R8005 and C8004)

1. Adjust Type 74-03 (inserted in Y cavity) as follows:

a. Set Sweep Mode switch to RECUR SWP and SWEEP RATE switch to 5 mSEC/CM.

b. Connect a lead from the GATE OUT connector on the Time Base Module to the NDT EXT TRIG connector on the Delaying Sweep Module.

2. Temporarily ground the base of the horizontal input emitter follower, Q8301.

3. Set NDT TIME/CM control (plastic skirt) to 0.5 mSEC and the DA TIME/CM control to 50 μSEC.

4. Set DISPLAY LOGIC switch to Triggered STROBE and the NDT TRIGGER SOURCE switch to EXT.

5. Adjust the NDT TRIG LEVEL control until a vertical line appears.

6. Adjust the DELAY VERNIER control until a strobed (brightened) section appears which may be offset from the vertical line.

7. Adjust the STROBE PATTERN CORR potentiometer, R8005, until the strobed section is coincident with the vertical line.

8. Set SWEEP RATE of Time Base Module to 1 μSEC/CM.

9. Set NDT TIME/CM switch to 0.5 μSEC and the DA TIME/CM switch to 0.1 μSEC.

10. Adjust trimmer C8004 for minimum overshoots at both ends of the strobed section.

11. Disconnect the ground lead from Q8301 and reset DISPLAY LOGIC switch to NORMAL. Replace the Time Base unit in the Y cavity with the Y Amplifier Plug-in Unit.

g. Fast Sweep Calibration Adjustment (C8556 and C8506)

1. Apply a 10-microsecond time marker signal from a Tektronix Type 180A Generator through a properly terminated cable to Input connector on the Y Plug-in.

2. Adjust the VOLTS/DIV switch to give the display a vertical amplitude of about 4 centimeters.

3. Set both the NDT and DA TIME/CM switches to 2 μSEC.

4. Using an insulated screwdriver, adjust trimmer, C8556, until one cycle of the time-marker signal occupies precisely 5 centimeters.

5. Set the DISPLAY LOGIC switch from NORMAL to Triggered DELAYED.

6. Repeat step 5 except adjust trimmer C8506.

h. Delay Zero Adjustment, Type 74-13 Only (R8618)

1. Set DISPLAY LOGIC switch to Triggered STROBE and obtain a convenient display.

2. Set DELAY VERNIER dial to Zero.

3. If the strobed section is still visible, adjust the front-panel screwdriver DELAY ZERO control until the strobed section just disappears.

j. Delay Cal Adjustment, Type 74-13 Only (R8614)

1. Apply a 100-microsecond time-marker signal from Tektronix Type 180A Generator through a properly terminated cable to Input connector on the Y Plug-in.

2. Set NDT TIME/CM switch to 0.1 mSEC and DA TIME/CM switch to 5 μSEC.

3. Set DELAY VERNIER dial to 5 cm and adjust the DELAY CAL potentiometer, R8614, so that the strobed section starts approximately at the 5-cm mark.

4. Set DELAY VERNIER dial to 0.8 cm and DISPLAY LOGIC switch to Triggered DELAYED.

5. Position the display so that the pulse is bisected by the vertical center line, $\pm$0.5 mm.

6. Advance the DELAY VERNIER dial to 5.8 cm. (Be sure that the Positioning and Trigger Level settings are not disturbed.)

7. Adjust the DELAY CAL potentiometer, R8614, so that the pulse is again centered, $\pm$0.5 mm.

8. Back-off DELAY VERNIER dial to 0.8 cm and check whether or not the pulse is again centered. If not, center the pulse and recheck step 7. This procedure may have to be repeated several times until the 0.8 cm pulse and the 5.8 cm pulse are centered, $\pm$0.5 mm.

SECTION 3
PERFORMANCE ASSURANCE TEST

3-1. MAINTENANCE CHECK TO ASSURE PERFORMANCE

The tests described in the paragraphs to follow should be performed by Instrument Test Departments and Maintenance Laboratories to certify proper performance. These tests are divided into sections for simplification and to assist those test groups where complete checking is not mandatory, or where all test equipment is not available. Refer to Section 2, paragraph 2-12 for list of test equipment required.

NOTE

All tests are performed with a representative Type 765 Series Main Frame Oscilloscope and a Y Amplifier Plug-in. Both of the plug-in units must be normalized to the Main Frame before starting tests. This is accomplished by adjusting the front-panel screwdriver SWP CAL and GAIN CAL controls as described in the appropriate Plug-in Instruction Manuals.

Allow 30 to 60 minutes of warm-up time before making any adjustments.

If after performing all the tests outlined the unit does not conform to specifications, the assistance of the local Du Mont Field Engineering representative should be requested.

3-2. CHECKING TRIGGER SOURCE AND POLARITY

1. Preset front-panel controls as indicated:

Control	Setting
TRIG LEVEL	Zero
DISPLAY LOGIC	NORMAL
TRIGGER SOURCE	LINE
TRIGGER COUPLING	AC
TRIGGER SLOPE	+
NDT TIME/CM (NDT & DA)	5 mSEC
TIME/CM VERNIER	CAL (fully ccw)
VOLTS/DIV (Y Plug-in)	CAL
PULL X5	Pushed in (X1)
POSITION	Centered

2. Three cycles of the calibrator pattern should be observed on the screen.

3. Set the NDT TRIGGER SOURCE switch to INT; the pattern remains stationary on the screen.

4. Set the NDT TRIGGER SOURCE switch to EXT; the display should disappear.

5. Using a probe, apply the CAL 1V signal to the NDT EXT TRIG connector. The amplitude of this signal should be sufficient to trigger the sweep and the pattern should again remain stationary on the screen.

6. Changing the NDT TRIGGER SLOPE switch from plus to minus, should change the leading edge of the first cycle from positive-going to negative-going.

7. Reset the NDT TRIGGER SOURCE and SLOPE switches to INT and plus respectively.

8. Set DISPLAY LOGIC switch to DELAYED ARMED and adjust DELAY VERNIER control until the calibrator pattern appears on the screen.

9. Set the DA TRIGGER SOURCE switch to INT; the delayed-armed display should remain stationary on the screen.

10. Set the DA TRIGGER SOURCE switch to EXT; the delayed-armed display should disappear.

11. Repeat steps 5, 6, and 7 except that the DA EXT TRIG connector, the DA TRIGGER SOURCE and SLOPE switches are used.

3-3. CHECKING SWEEP CALIBRATION

1. Connect a Tektronix Type 180A Time-Mark Generator to the Input connector of the Y Plug-in through a properly terminated cable.

2. Sweep accuracy is checked by counting the positive peaks in the centered 8-centimeter portion of the CRT scale. Make sure the UNCAL lamp is off and refer to the accompanying chart for additional data. All measurements indicated in this chart should fall within ± 2.5 mm of the 9-centimeter marking; if not, refer to step 3.

3. For precise calibration, the entire sweep range may be normalized by adjustment of the front-panel SWP CAL control as follows:

a. Using the Time-Mark Generator, determine the sweep range in greatest error.

b. When this "most-off" range has been located, readjust the SWP CAL control to bring this range within the $\pm 3\%$ limit. All other ranges will then be within $\pm 3\%$ of the absolute value represented by the Time-Mark Generator.

SWEEP CALIBRATION CHART

TIME-MARK GEN set to	TIME/CM set to	NUMBER OF POSITIVE PULSES*
10 Mc sine wave	0.1 μSEC	9 cycles
5 Mc sine wave	0.2 μSEC	9 cycles
1 μsec marker	0.5 μSEC	5 timing markers
1 μsec marker	1 μSEC	9 timing markers
1 μsec marker	2 μSEC	17 timing markers
5 μsec marker	5 μSEC	9 timing markers
10 μsec marker	10 μSEC	9 timing markers
10 μsec marker	20 μSEC	17 timing markers
50 μsec marker	50 μSEC	9 timing markers
100 μsec marker	0.1 mSEC	9 timing markers
100 μsec marker	0.2 mSEC	17 timing markers
500 μsec marker	0.5 mSEC	9 timing markers
1 msec marker	1 mSEC	9 timing markers
1 msec marker	2 mSEC	17 timing markers
5 msec marker	5 mSEC	9 timing markers
10 msec marker	10 mSEC	9 timing markers
10 msec marker	20 mSEC	17 timing markers
50 msec marker	50 mSEC	9 timing markers
100 msec marker	0.1 SEC	9 timing markers
100 msec marker	0.2 SEC	17 timing markers
500 msec marker	0.5 SEC	9 timing markers
1 sec marker	1 SEC	9 timing markers
5 sec marker	2 SEC	7 timing markers

* Centered 8-cm portion of scale

3-4. CHECKING NORMAL, TRIGGERED & ARMED SWEEP DISPLAYS

Refer to the following illustrations in Section 1, Operation, to check the sweep modes available at the different settings of the DISPLAY LOGIC switch.

Figure 1-5. Type 74-11 Normal Display
Figure 1-6a. Type 74-11 Triggered Strobe Display
Figure 1-6b. Type 74-11 Delayed Triggered Display
Figure 1-7a. Type 74-11 Armed Strobe Display
Figure 1-7b. Type 74-11 Armed Delayed Display
Figure 1-8. Type 74-13 Normal Display
Figure 1-9a. Type 74-13 Triggered Strobe Display
Figure 1-9b. Type 74-13 Delayed Triggered Display

The Type 74-13 Delayed-Armed displays are similar to those shown for the Type 74-11 (Figures 1-7a and 1-7b).

Unless otherwise designated, it is presumed that a Y Amplifier Plug-in module is inserted in the Y cavity (left-hand side) and the Du Mont Type 74-11 or 74-13 Time Base Plug-in unit is inserted in the X cavity (right-hand side) of the Main Frame.

3-5. DELAY CALIBRATION CHECK (TYPE 74-13 Only)

1. Allow the unit to warm up at least 10 minutes at an ambient temperature of 25°C ±5°C (77°F ±9°F).

2. Apply a 100 μsec marker from the Tektronix 180A Time-Mark Generator to the Input connector of the Y Plug-in unit through a properly terminated cable.

3. Set NDT TIME/CM switch to 0.1 mSEC and DA TIME/CM switch to 5 μSEC.

4. Set the DISPLAY LOGIC switch to Triggered DELAYED.

5. Measure the incremental accuracy of the delay calibration from 0.8 cm to 9.8 cm in steps of 1 cm (i.e., 1.8 cm, 2.8 cm, etc.). One complete revolution of the DELAY VERNIER dial, say from 3.8 cm to 4.8 cm, should bring the succeeding pulse back to the position occupied by the preceding pulse within ±1cm.

NOTE: Be sure that the positioning and Trigger Leveling settings are not disturbed during this check.

6. Center the pulse when the dial is set to 9.8 cm. Turning the DELAY VERNIER dial back to 0.8 cm should bring the pulse back on screen within ±2 cm from the center line.

SECTION 4
ELECTRICAL PARTS LIST AND SCHEMATICS
TYPES 74-11/74-13 DELAYING SWEEP

CAPACITORS

Notes: 1. All capacitors are fixed, ceramic, and 500V unless otherwise specified; pf denotes picofarads.
2. GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C8001	0317 5100	mica, 20 pf	EMC	DM15
C8002	0326 5800	plastic, 0.1 µf, ±20%, 150V	GUD	355Y
C8003	0317 3840	330 pf, ±10%	EIA	
C8004	0326 9480	variable, air, 9-35 pf	ERC	Style 538
C8101	0316 7200	4.7 pf, ±0.25 pf	ERC	NPO-SI-1
C8102	0319 1060	0.01 µf, +60 —40%, 150V	CRL	DDM
C8103	0315 2000	100 pf, ±20%	EIA	
C8104	0326 4520	1000 pf, GMV	ERC	
C8105	0315 3720	2200 pf, +100 —0%	ERC	
C8106	0319 1050	0.02 µf, +60 —40%, 150V	CRL	DDM
C8107	0326 8490	paper, 0.1 µf, ±20%, 200V	HOP	Part #P12D
C8108 & C8109	0314 6850	5.6 pf, ±1%	EIA	
C8111	0319 1050	0.02 µf, +60 —40%, 150V	CRL	DDM
C8112	0315 3720	2200 pf, +100 —0%	ERC	
C8113	0316 0330	39 pf	EIA	
C8114	0319 1050	0.02 µf, +60 —40%, 150V	CRL	DDM
C8116	0317 5110	mica, 22 pf	EMC	DM15
C8117	0319 1050	0.02 µf, +60 —40%, 150V	CRL	DDM
C8118	0316 0270	22 pf	EIA	
C8120	0315 3610	100 pf, ±10%	EIA	
C8121	0317 5110	mica, 22 pf	EMC	DM15
C8122	0315 3610	100 pf, ±10%	EIA	
C8123	0318 6230	0.1 µf, +80 —20%, 100V	RMC	BT
C8124	0317 5100	mica, 20 pf	EMC	DM15
C8126	0305 5600	mica, 47 pf, ±10%	EIA	
C8127	0317 5100	mica, 20 pf	EMC	DM15
C8128	0319 1050	0.02 µf, +60 —40%, 150V	CRL	DDM
C8129	0315 3620	120 pf, ±10%	EIA	
C8131	0319 1060	0.01µf, +60 —40%, 150V	CRL	DDM
C8132	0316 4180	9.1 pf, 1000V	RMC	C
C8133	0319 1060	0.01µf, +60 —40%, 150V	CRL	DDM
C8134	0326 7880	plastic, 0.22 µf, ±10%, 125V	AMX	C296AA
C8136	0326 7880	plastic, 0.22 µf, ±10%, 125V	AMX	C296AA
C8137	0326 9480	variable, 9-35 pf, 100V	ERC	Style 538
C8201	0316 7200	4.7 pf, ±0.25 pf	ERC	NPO-SI-1
C8202	0326 4520	1000 pf, GMV	ERC	
C8203	0315 2000	100 pf, ±20%	EIA	
C8204	0319 1050	0.02 µf, +60 —40%, 150V	CRL	DDM
C8205	0315 3720	2200 pf, +100 —0%	ERC	
C8206	0319 1060	0.01 µf, +60 —40%, 150V	CRL	DDM
C8208 & C8209	0314 6860	5.6 pf, ±1%	EIA	
C8211	0326 8490	paper, 0.1 µf, ±20%, 200V	HOP	No. P12D
C8213	0319 1050	0.02 µf, +60 —40%, 150V	CRL	DDM
C8214	0315 3720	2200 pf, +100 —0%	ERC	
C8216	0305 5600	mica, 47 pf, ±10%	EIA	
C8217	0318 6230	0.1 µf, +80 —20%, 100V	RMC	BT
C8218	0317 5100	mica, 20 pf	EMC	DM15
C8219	0315 3630	150 pf, ±10%	EIA	
C8221	0317 5100	mica, 20 pf	EMC	DM15
C8223	0305 5850	mica, 510 pf, ±10%, 300V	EIA	
C8224	0315 3610	100 pf, ±10%	EIA	
C8228	0319 1060	0.01 µf, +60 —40%, 150V	CRL	DDM
C8229	0316 4180	9.1 pf, 1000V	RMC	C
C8231 & C8232	0326 7880	plastic, 0.22 µf, ±10%, 125V	AMX	C296AA
C8233	0319 1060	0.01 µf, +60 —40%, 150V	CRL	DDM
C8234	0315 1920	220 pf, ±10%	ERC	Style 331GP2
C8235	0317 3200	12 pf, ±10%	CRL	
C8301	0319 1060	0.01 µf, +60 —40%, 150V	CRL	DDM
C8302	0316 7200	4.7 pf, ±0.25 pf	ERC	NPO-331
C8303	0326 9480	variable, 9-35 pf, 100V	ERC	Style 538
C8304	0316 0320	36 pf	EIA	
C8306 & C8307	0319 1050	0.02 µf, +60 —40%, 150V	CRL	DDM
C8308	0326 9330	0.47µf, ±20%, 50V	SPG	Cat. #5C54
C8309	0326 9500	variable, air, 5.5-18 pf, 200V	ERC	538
C8311	0326 9330	0.47 µf, ±20%, 50V	SPG	No. 5054
C8312	0319 1050	0.02 µf, +60 —40%, 150V	CRL	DDM
C8313	0326 7880	plastic, 0.22 µf, ±10%, 125V	AMX	C296AA
C8314	0326 8080	plastic, 0.22 µf, ±10%, 400V	AMX	C296AC
C8316	0315 2000	100 pf, ±20%	EIA	
C8317	0326 9480	variable, ceramic, 9-35 pf, 100V	ERC	Style 538
C8401 to C8403	0319 1050	0.02 µf, +60 —40%, 150V	CRL	DDM
C8404	0326 8490	paper, 0.1 µf, ±20%, 200V	HOP	Part #P12D
C8405	0327 1630	electrolytic, 2 µf, +100 —10%, 100V	SPG	Series TE "Little-Lytic"
C8406	0319 9860	plastic, 0.1 µf, ±20%, 400V	GUD	No. 355E
C8407	0319 1060	0.01 µf, +60 —40%, 150V	CRL	DDM
C8408	0326 9330	0.47 µf, ±20%, 50V	SPG	Cat. #5C54
C8409	0317 6750	mica, 1000 pf	EMC	DM20
C8411	0316 0330	39 pf	EIA	
C8412 & C8413	0319 1060	0.01 µf, +60 —40%, 150V	CRL	DDM
C8414	0316 0330	39 pf	EIA	
C8441	0316 7280	10 pf, ±0.25 pf	ERC	NPO-331
C8442 & C8443	0326 4520	1000 pf, GMV	ERC	
C8446 & C8447	0326 4520	1000 pf, GMV	ERC	
C8449	0326 4520	1000 pf, GMV	ERC	
C8451	0326 4520	1000 pf, GMV	ERC	
C8501	0327 1560	mica, 348 pf, ±1%	EMC	DM15
C8502	0327 1500	mica, 3831 pf, ±1%	EMC	DM19
C8503	0326 8780	plastic, 0.03866 pf, ±1%, 100V	GUD	355B
C8504	0316 0310	33 pf	EIA	
C8506	0326 9490	variable, air, 2-8 pf, 200V	ERC	Style 538
C8507	0326 8760	plastic, 0.86 µf, ±1%, 100V	GUD	355B
C8508	0316 4180	9.1 pf, 1000V	RMC	C
C8509	0316 3790	27 pf, 1000V	RMC	C
C8510	0316 3850	47 pf, 1000V	RMC	C
C8551	0327 1560	mica, 348 pf, ±1%	EMC	DM15
C8552	0327 1500	mica, 3831 pf, ±1%	EMC	DM19
C8553	0326 8780	plastic, 0.03866 pf, ±1%, 100V	GUD	355B
C8554	0316 0310	33 pf	EIA	
C8556	0326 9490	variable, air, 2-8 pf, 200V	ERC	Style 538
C8557	0326 8760	plastic, 0.86 µf, ±1%, 100V	GUD	355B
C8558	0302 9840	mica, 4700, ±10%	EIA	
C8559	0319 6250	plastic, 0.05µf, ±10%, 150V	GUD	S'r's 338Y-K
C8560	0316 4180	9.1 pf, 1000V	RMC	C
C8561	0316 3790	27 pf, 1000V	RMC	C
C8562	0316 3850	47 pf, 1000V	RMC	C
C8563	0326 7930	plastic, 1 µf, ±10%, 125V	AMX	C296AA
C8601	0319 1050	0.02 µf, +60 —40%, 150V	CRL	DDM
C8602	0318 6230	0.1 µf, +80 —20%, 100V	RMC	BT

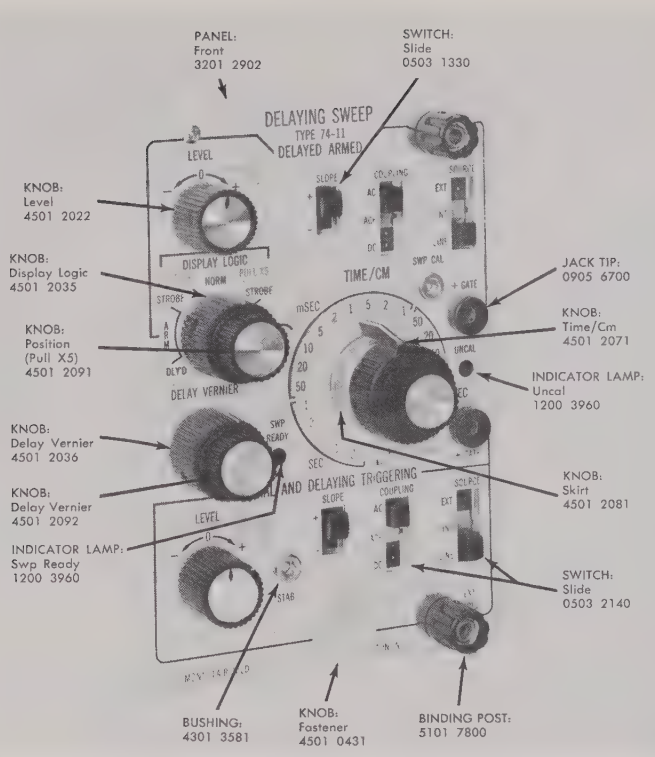


FIGURE 4-1. IDENTIFICATON OF REPLACEABLE PARTS

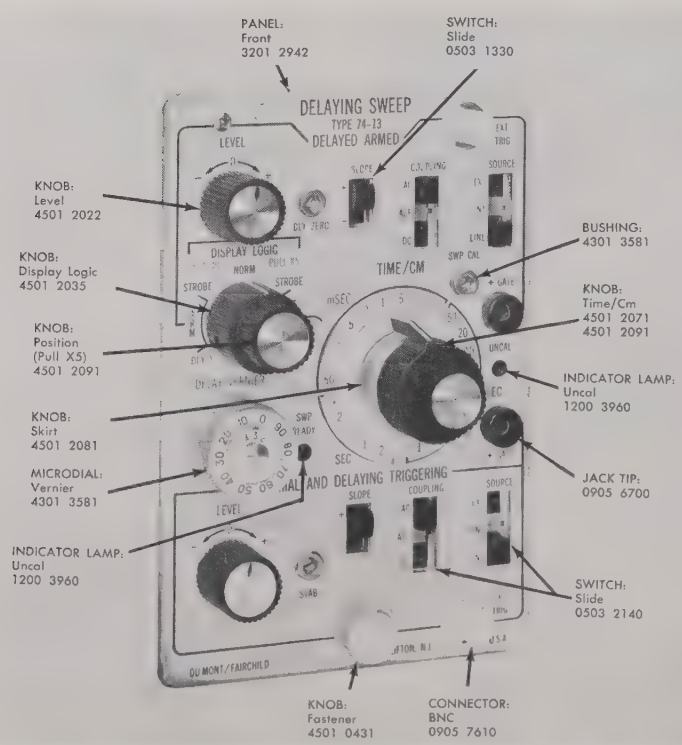


FIGURE 4-2. IDENTIFICATION OF REPLACEABLE PARTS

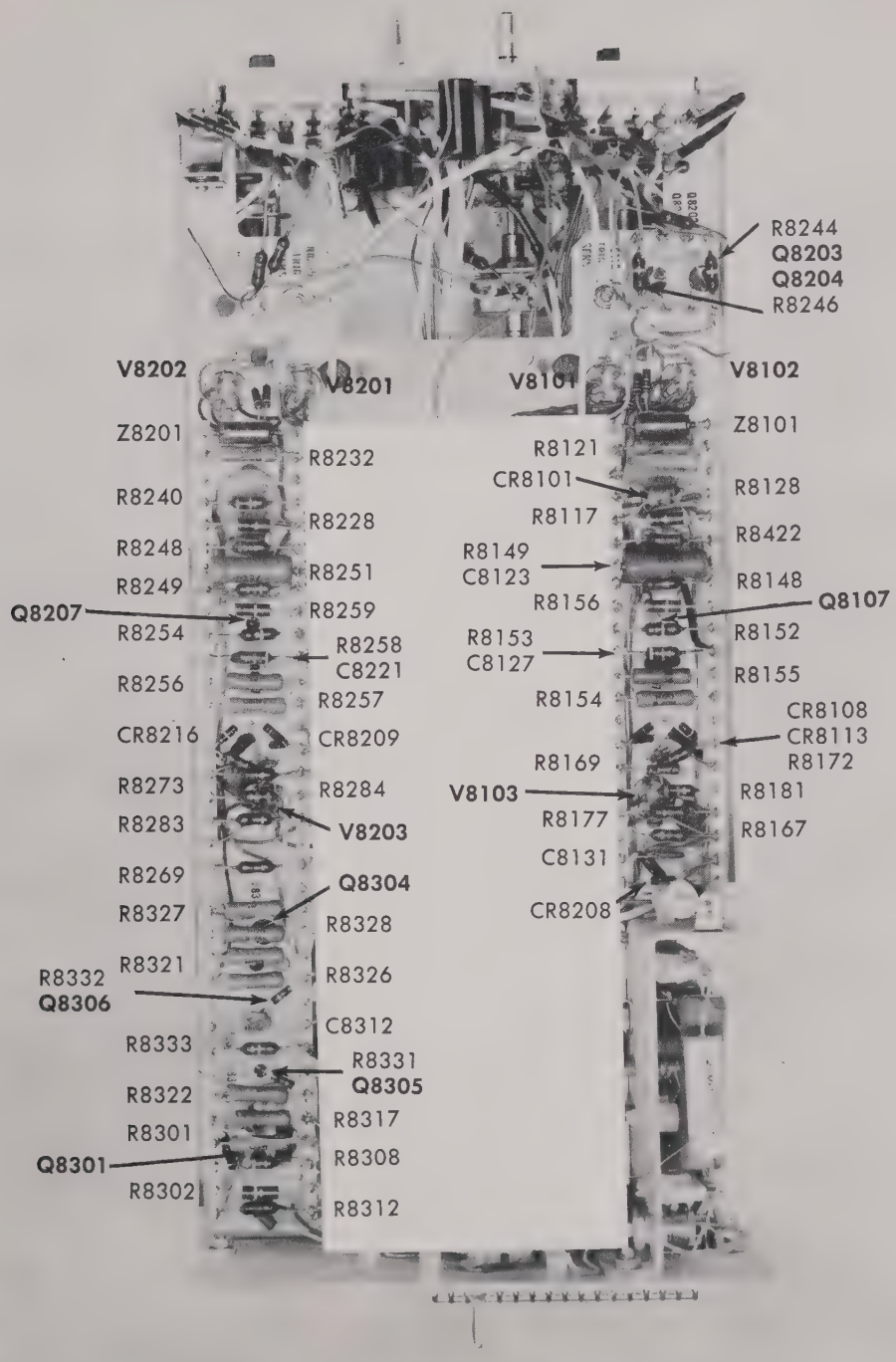


FIGURE 4-3a. IDENTIFICATION OF REPLACEABLE PARTS (Right Side View) SHOWN WITH TIME/CM SWITCH REMOVED

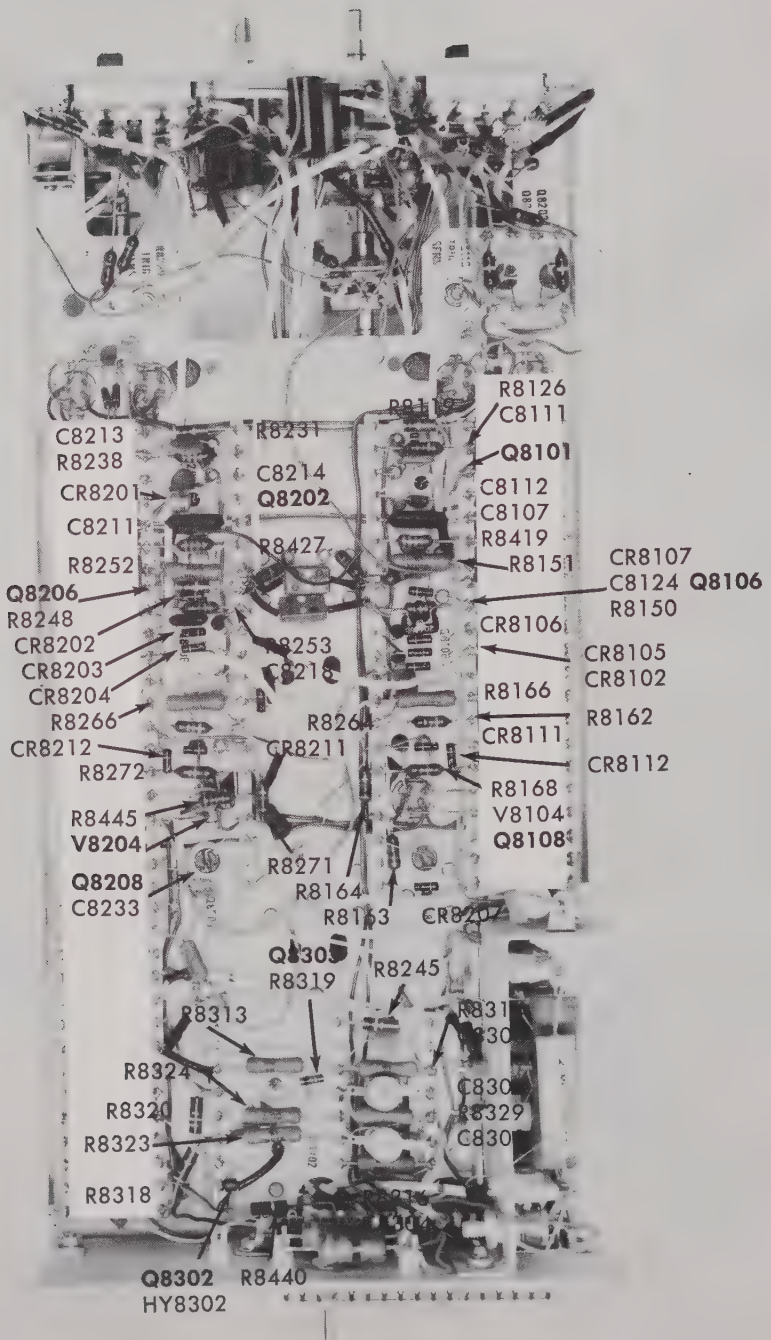


FIGURE 4-3b. IDENTIFICATION OF REPLACEABLE PARTS (Right Side View) SHOWN WITH TIME/CM SWITCH REMOVED

Symbol	Part Number	Description	Recommended Vendor Code	Type
C8603 (74-11)	0326 9330	0.47 µf, ±20%, 50V	SPG	Cat. #5C54
C8604	0315 3720	2200 pf, +100 −0%	ERC	
C8606	0326 9480	variable, air, 9-35 pf, 100V	ERC	Style 538
C8607	0326 7630	electrolytic, 10 µf, +100 −10%, 50V	SPG	"Littl-Lytic"
C8608 (74-13)	0319 1060	0.01 µf, +60 −40%, 150V	CRL	DDM
C8611	0319 1050	0.02 µf, +60 −40%, 150V	CRL	DDM

SEMICONDUCTORS

CR8001	2600 6910	diode, FD841	FCI	
CR8101	2600 7900	diode, HT63	HOF	HT63 ±10%
CR8102 to CR8109	2600 6910	diode, FD841	FCI	
CR8111 & CR8112	2600 6910	diode, FD841	FCI	
CR8113	2600 8020	diode, FDG3091	FCI	
CR8201	2600 7900	diode, HT63	HOF	HT63 ±10%
CR8202 to CR8204	2600 6910	diode, FD841	FCI	
CR8206 to CR8209	2600 6910	diode, FD841	FCI	
CR8211 & CR8212	2600 6910	diode, FD841	FCI	
CR8213	2600 6910	diode, FD841	FCI	
CR8216	2600 8020	diode, FDG3091	FCI	
CR8401	2600 6820	diode, FD281	FCI	
CR8402	2600 6910	diode, FD841	FCI	
CR8403	2600 6820	diode, FD281	FCI	
CR8404	2600 6910	diode, FD841	FCI	
CR8406	2600 6910	diode, FD841	FCI	
CR8601	2600 7900	diode, HT63	HOF	HT63 ±10%
CR8602 & CR8603	2600 6910	diode, FD841	FCI	

LAMPS

DS8101	1200 3960	neon, 0.3 milliamperes, 1/25W (SWP READY)	GE	NE-2
DS8201	1200 3960	neon, 0.3 milliamperes, 1/25W (UNCAL)	GE	NE-2
E8101	1200 3960	glow, neon, NE-2	GE	NE-2
E8201	1200 3960	glow, neon, NE-2	GE	NE-2

HYBRID COILS

HY8302	2110 1560	Bead, ferrite	FER	Part No. 56-590-65/3B
HY8603	2110 1560	Bead, ferrite	FER	Part No. 56-590-65/3B

ELECTRICAL CONNECTORS

J8100 & J8200 (74-11)	5101 7800	binding post, black (EXT TRIG)	GRY	Series 29
J8100 & J8200 (74-13)	0905 7610	receptacle, rf, type BNC, female 1 contact (EXT TRIG)		UG 625A/U
J8401 & J8402	0905 6700	jack tip, banana type, insulated, black (GATE)	JHN	108
P8001	0905 7340	plug, male, 32 contacts	APH	26-159-32

Symbol	Part Number	Description	Recommended Vendor Code	Type

TRANSISTORS

Q8001	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q8002	2600 7370	DU #8A/2N699B	ABD/FCI	8A/2N699B
Q8101	2600 7410	DU #9	FCI	
	2600 7400	alternate 2N869		
Q8102	2600 7260	DU #6	FCI	
	2600 7250	alternate 2N1893		
Q8103	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q8104	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q8106	2600 2732	DU #1AH	FCI	
Q8107	2600 2733	DU #1AL	FCI	
	2600 7000	alternate 2N914		
Q8108	2600 7260	DU #6	FCI	
	2600 7250	alternate 2N1893		
Q8202	2600 7410	DU #9	FCI	
	2600 7400	alternate 2N869		
Q8203 & Q8204	2600 7170	DU #4A	FCI	
	2600 7150	alternate 2N1132		
Q8206	2600 2732	DU #1AH	FCI	
Q8207	2600 2733	DU #1AL	FCI	
	2600 7000	alternate 2N914		
Q8208	2600 7260	DU #6	FCI	
	2600 7250	alternate 2N1893		
Q8301 & Q8303	2600 7080	DU #2B	FCI	
	2600 7050	alternate 2N915		
Q8304	2600 7260	DU #6	FCI	
	2600 7250	alternate 2N1893		
Q8305 & Q8306	2600 7080	DU #2B	FCI	
	2600 7050	alternate 2N915		
Q8307	2600 8090	DU #8D	FCI	
	2600 8080	alternate 2N2102		
Q8308 & Q8309	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q8311	2600 8090	DU #8D	FCI	
	2600 8080	alternate 2N2102		
Q8401	2600 7180	DU #4B	FCI	
	2600 7150	alternate 2N1132		
Q8402	2600 7270	DU #6A	FCI	
	2600 7250	alternate 2N1893		
Q8403	2600 7370	DU #8A/2N699B	ABD/FCI	8A/2N699B
Q8404 & Q8405	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q8601 & Q8602	2600 7070	DU #2A	FCI	
	2600 7050	alternate 2N915		
Q8603	2600 7260	DU #6	FCI	
	2600 7250	alternate 2N1893		
Q8604	2600 7010	DU #1	FCI	
	2600 7000	alternate 2N914		

RESISTORS

Note: All resistors are fixed, film, ±5%, and ½W. Values are in ohms unless otherwise specified; K = thousand, M = million

R8001	0234 8670	82K	CGW	C-20
R8002	0234 8510	18K	CGW	C-20
R8003	0203 2130	composition, 1M, ±10%	CGW	C-20
R8004	0234 9220	5.1K, 1W	CGW	C-32
R8005	0109 1510	variable, composition, 1K, ±10% 2W (STROBE PATTERN CORR)	ALB	JU

Symbol	Part Number	Description	Recommended Vendor Code	Type
R8006	0234 8210	1K	CGW	C-20
R8007	0234 7950	82	CGW	C-20
R8008	0228 3810	1.5K, 3W	CGW	LPI-3
R8009	0234 7970	100	CGW	C-20
R8011	0234 8010	150	CGW	C-20
R8012	0109 0810	variable, composition, 250, ±20%, .3W (STROBE ADJ)	CTS	Series 70
R8013	0234 8530	22K	CGW	C-20
R8101	0204 0970	composition, 110K	IRC	GBT ½
R8102	0204 1190	composition, 910K	IRC	GBT ½
R8103	0235 4850	composition, 10K, ¼W	ALB	CB
R8104	0234 8450	10K	CGW	C-20
R8106	0235 5170	composition, 220K, ¼W	ALB	CB
R8107	0235 5330	composition, 1M, ¼W	ALB	CB
R8108	0234 8290	2.2K	CGW	C-20
R8109	0234 8580	36K	CGW	C-20
R8111	0107 2393	variable, composition, 500K, ±20% (TRIG LEVEL)	ABD	
R8112	0234 8580	36K	CGW	C-20
R8113 (74-11)	0234 8520	20K	CGW	C-20
R8113 (74-13)	0234 8460	11K	CGW	C-20
R8114	0234 7970	100	CGW	C-20
R8116	0235 4410	composition, 130, ¼W	ALB	CB
R8117	0203 0110	composition, 30, ¼W	ALB	EB
R8118	0107 5900	variable, composition, 100, ±20% (TRIG SENS)	CTS	65
R8119	0203 0110	composition, 30	ALB	EB
R8121	0236 0460	15.4K, ±1%	CGW	NI-20
R8122	0236 2880	wire wound, 5.8K, ±1%, 2W	DAL	RS-2A
R8123	0234 7970	100	CGW	C-20
R8124	0235 4410	composition, 130, ¼W	ALB	CB
R8126	0234 8540	24K	CGW	C-20
R8127	0235 4300	composition, 47, ¼W	ALB	CB
R8128	0234 8560	30K	CGW	C-20
R8129	0203 2090	composition, 470K, ±10%	ALB	EB
R8131	0203 2090	composition, 470K, ±10%	ALB	EB
R8132	0234 8080	300	CGW	C-20
R8133	0235 824	1.1K, ±1%	CGW	NI-20
R8134	0234 9190	3.9K, 1W	CGW	C-32
R8135	0234 8610	47K	CGW	C-20
R8136 & R8137	0203 1910	composition, 15K, ±10%	ALB	EB
R8138	0235 9240	1.1K, ±1%	CGW	NI-20
R8140	0234 8110	390	CGW	C-20
R8141 & R8142	0203 1170	composition, 750K	ALB	EB
R8143	0234 8640	62K	CGW	C-20
R8144	0234 8450	10K	CGW	C-20
R8145 & R8146	0234 8610	47K	CGW	C-20
R8147	0234 8110	390	CGW	C-20
R8148	0234 8010	150	CGW	C-20
R8149	0234 6160	750 ±1%, 2W	CGW	SI-25
R8150	0234 8480	13K	CGW	C-20
R8151	0228 7130	953, ±1%, 1W	CGW	SI-20
R8152	0203 1170	composition, 750K	ALB	EB
R8153	0234 8440	9.1K	CGW	C-20
R8154	0235 9600	2.49K, ±1%	CGW	NI-20
R8155	0239 1192	1K, ±1%, 1W	ABD	
R8156	0203 2130	composition, 1M, ±10%	ALB	EB
R8157 & R8158	0234 8450	10K	CGW	C-20
R8159	0109 0800	variable, composition, 1.5K, ±20%, .3W (SWP LENGTH)	CTS	Series 70
R8161	0234 9230	5.6K, 1W	CGW	C-32
R8162	0234 8270	1.8K	CGW	C-20
R8163	0234 8210	1K	CGW	C-20
R8164	0234 8320	3K	CGW	C-20
R8166	0236 0420	14K, ±1%	CGW	NI-20
R8167	0234 7970	100	CGW	C-20
R8168	0234 8450	10K	CGW	C-20
R8169	0234 8140	510	CGW	C-20
R8171	0234 9450	47K, 1W	CGW	C-32
R8172	0234 7970	100	CGW	C-32
R8173	0203 2070	composition, 330K, ±10%	ALB	EB
R8174	0234 8690	100K	CGW	C-20
R8176 & R8177	0234 7970	100	CGW	C-20
R8178	239 1392	6.8K, 2W	ABD	
R8179	0203 0160	composition, 47	ALB	EB
R8181	0234 8280	2K	CGW	C-20
R8182	0236 0920	41.2K, ±1%	CGW	NI-20
R8201	0204 0970	composition, 110K	IRC	GBT ½
R8202	0204 1190	composition, 910K	IRC	GBT ½
R8203	0235 4850	composition, 10K, ¼W	ALB	CB
R8204	0234 8450	10K	CGW	C-20
R8206	0235 5170	composition, 220K, ¼W	ALB	CB
R8207	0235 5330	composition, 1M, ¼W	ALB	CB
R8208	0234 8290	2.2K	CGW	C-20
R8217	0234 7970	100	CGW	C-20
R8218	0235 4410	composition, 130, ¼W	ALB	CB
R8221	0234 8580	36K	CGW	C-20
R8222	0107 2393	variable, composition, 500K, ±20% (TRIG LEVEL)	ABD	
R8223	0234 8580	36K	CGW	C-20
R8224 (74-11)	0234 8520	20K	CGW	C-20
R8224 (74-13)	0234 8460	11K	CGW	C-20
R8225	0203 1940	Composition, 27K, ±10%	ALB	EB
R8226	0234 7970	100	CGW	C-20
R8227	0235 4410	composition, 130, ¼W	ALB	CB
R8228	0203 0110	composition, 30	ALB	EB
R8229	0107 5900	variable, composition, 100, ±20% (TRIG SENS)	CTS	65
R8231	0203 0110	composition, 30	ALB	EB
R8232	0236 0460	15.4K	CGW	NI-20
R8233	0236 2880	wire wound, 5.8K, ±1%, 2W	DAL	RS-2A
R8238	0234 8540	24K	CGW	C-20
R8239	0235 4240	composition, 27, ¼W	ALB	CB
R8240	0234 8560	30K	CGW	C-20
R8241 (74-11)	0109 0480	variable, composition, 2.5K, ±20%, .3W (SWP CAL)	CTS	Series 70
R8241 F/R (74-13)	0107 2701	variable, wire wound, 2.5K/10K, 2W (SWP CAL)	ABD	
R8242 (part of S850)	0107 2711	variable, wire wound, 2.5K, ±10%, 2W (SWP VERNIER)	ABD	
R8243 (74-11)	0234 8230	1.2K	CGW	C-20
R8243 (74-13)	0236 3190	wire wound, 1.2K, ±10%, 1W	CGW	C-20
R8244	0234 8690	100K	CGW	C-20
R8245	0203 1030	composition, 200K	ALB	EB
R8246	0234 8690	100K	CGW	C-20
R8247	0234 8450	10K	CGW	C-20
R8248	0203 2130	composition, 1M, ±10%	ALB	EB
R8249	0234 8030	180	CGW	C-20
R8251	0234 6160	750, ±1%, 2W	CGW	SI-25
R8252	0228 7130	953, ±1%, 1W	CGW	SI-20
R8253	0234 8480	13K	CGW	C-20
R8254	0234 8690	100K	CGW	C-20
R8256	0239 1192	1K, ±1%, 1W	ABD	

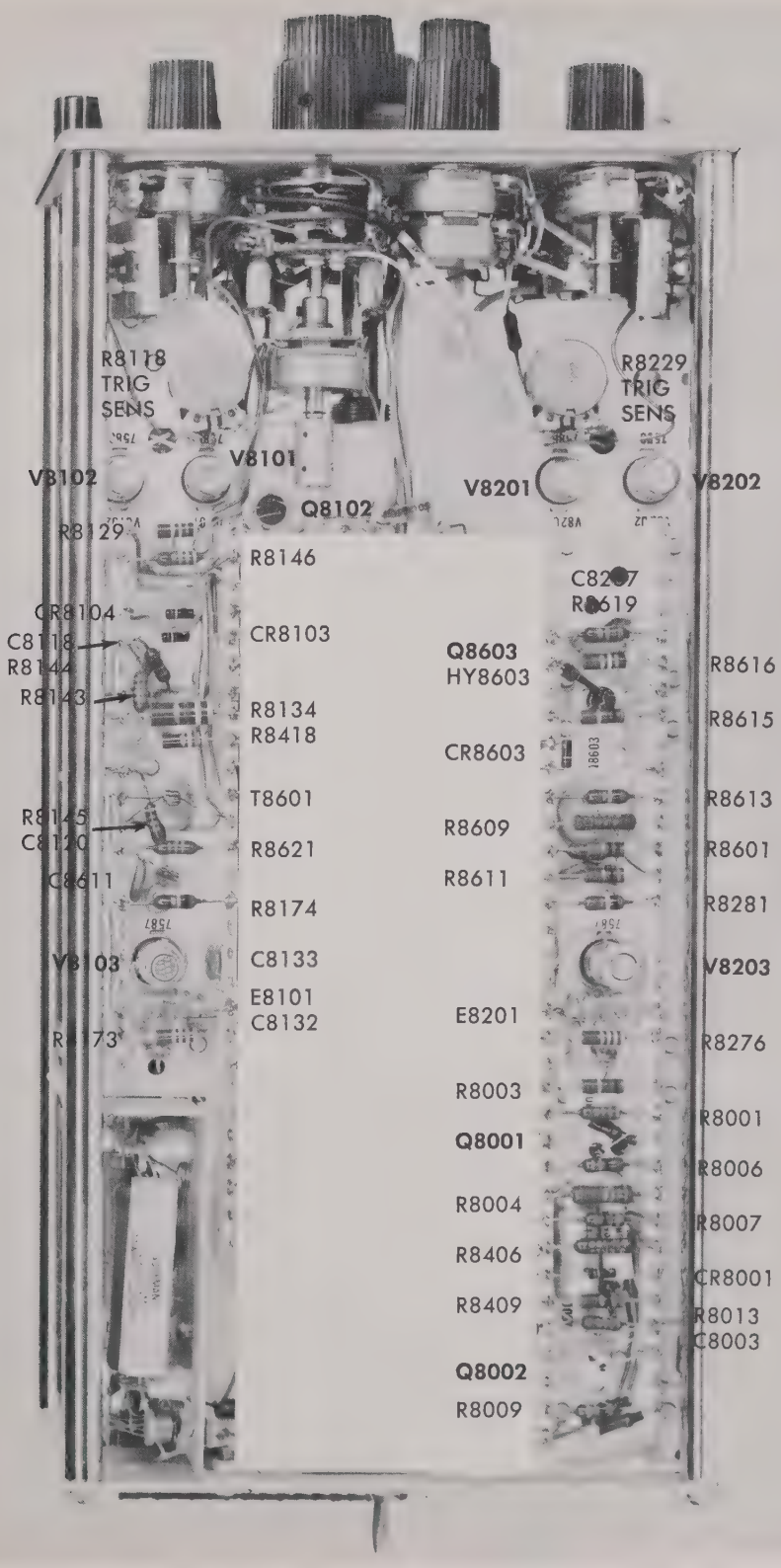


FIGURE 4-4a. IDENTIFICATION OF REPLACEABLE PARTS (Left Side View)

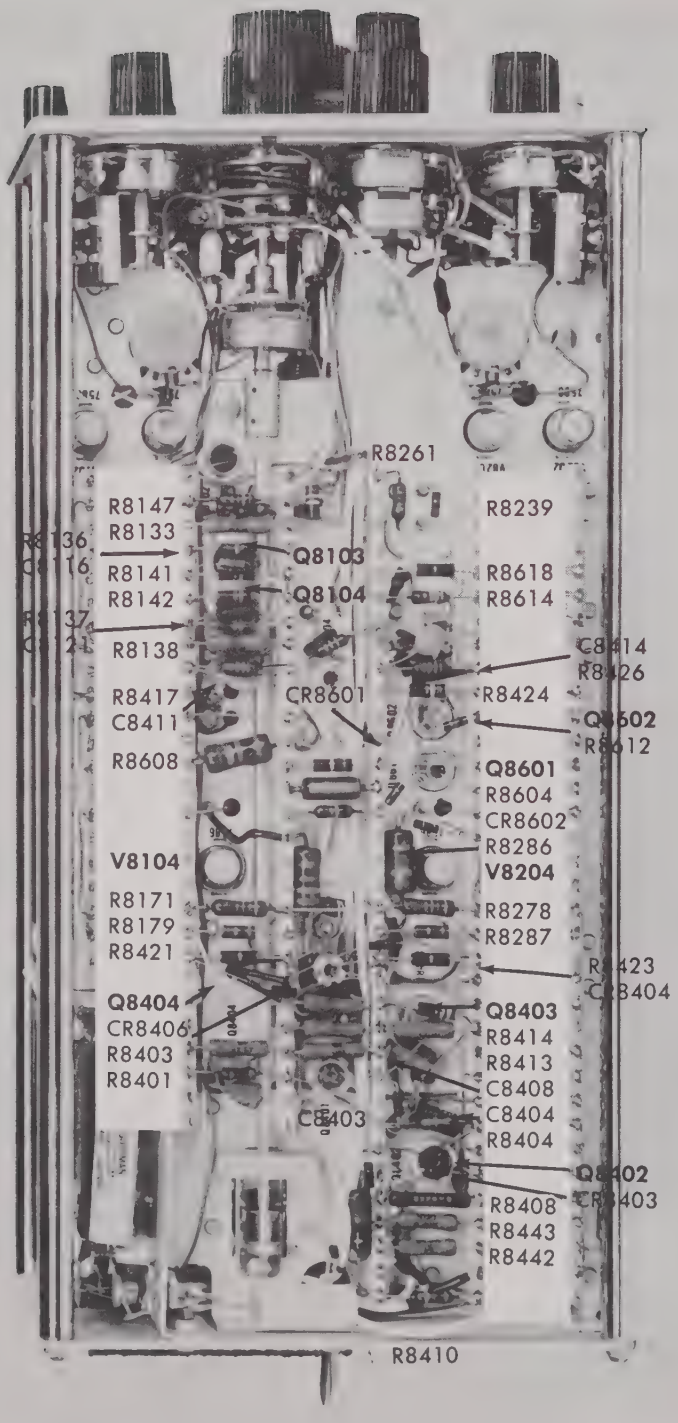


FIGURE 4-4b. IDENTIFICATION OF REPLACEABLE PARTS (Left Side View)

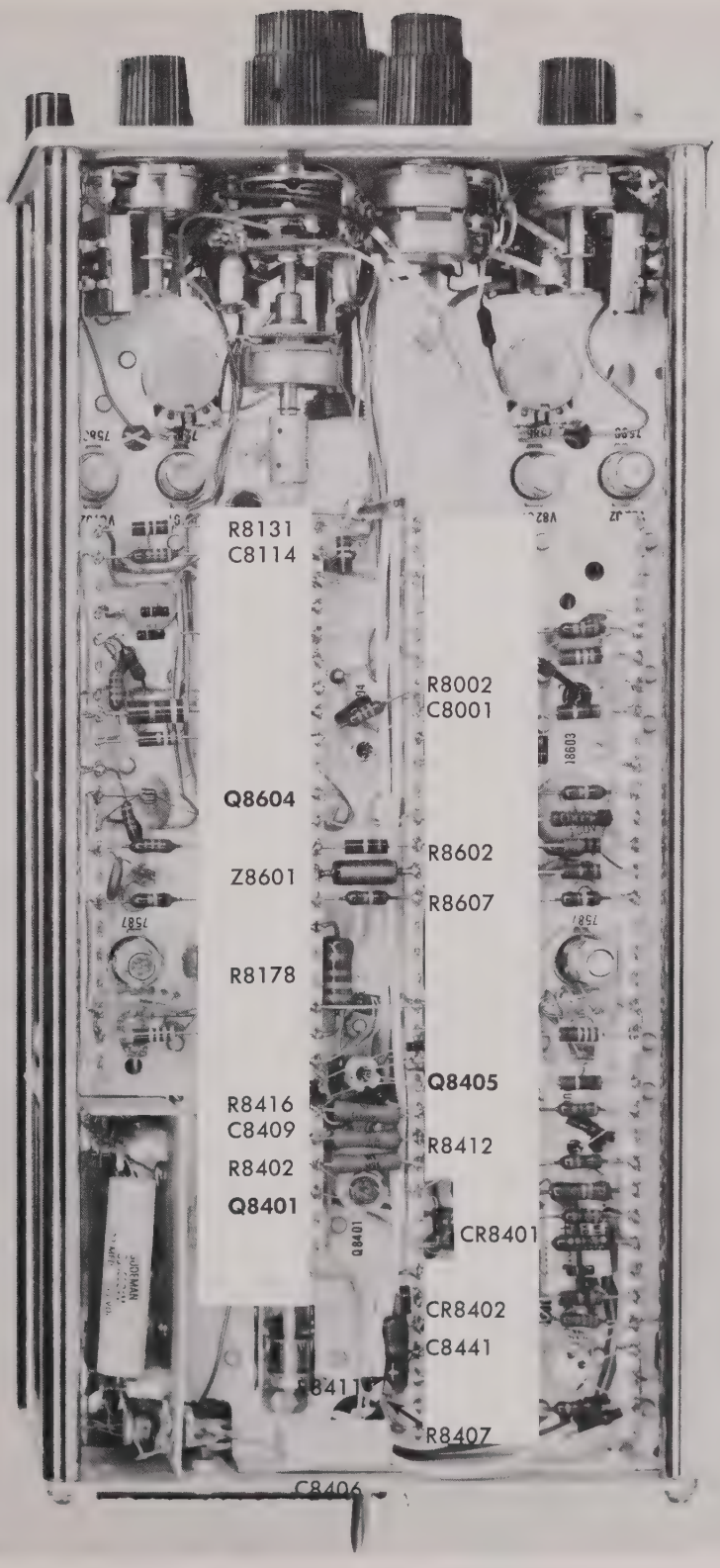


FIGURE 4-4c. IDENTIFICATION OF REPLACEABLE PARTS (Left Side View)

Symbol	Part Number	Description	Recommended Vendor Code	Type
R8257	0235 9600	2.49K, ±1%	CGW	NI-20
R8258	0234 8440	9.1K	CGW	C-20
R8259	0203 2130	composition, 1M, ±10%	ALB	EB
R8261	0234 8570	33K	CGW	C-20
R8262	0234 9230	5.6K, 1W	CGW	C-32
R8263	0109 0800	variable, composition, 1.5K, ±20%, .3W (SWP LENGTH)	CTS	Series 70
R8264	0234 8270	1.8K	CGW	C-20
R8266	0236 0420	14K, ±1%	CGW	NI-20
R8267	0234 8410	6.8K	CGW	C-20
R8268 (74-11)	0109 0490	composition, 250, ±20%, .3W (STAB)	CTS	Series 70
R8268 (74-13)	0109 1000	variable, wire wound, 250, ±10%, 1.5W (STAB)	CTS	49M
R8269	0234 7970	100	CGW	C-20
R8271	0234 8320	3K	CGW	C-20
R8272	0234 8450	10K	CGW	C-20
R8273	0234 8140	510	CGW	C-20
R8276	0203 2070	composition, 330K, ±10%	ALB	EB
R8278	0234 9450	47K, 1W	CGW	C-32
R8279	0234 7970	100	CGW	C-20
R8281	0234 8690	100K	CGW	C-20
R8282 & R8283	0234 7970	100	CGW	C-20
R8284	0234 8280	2K	CGW	C-20
R8286	0239 1392	6.8K, 2W	ABD	
R8287	0203 0160	composition, 47	ALB	EB
R8301	0236 0400	13.3K, ±1%	CGW	C-20
R8302	0203 1030	composition, 200K	ALB	EB
R8303	0234 8690	100K	CGW	C-20
R8306 (part of S840)	0107 2671	variable, 15K, ±10%, 1W (POSITION)	ABD	
R8308	0234 8000	130	CGW	C-20
R8309	0234 8430	8.2K	CGW	C-20
R8311	0109 0710	variable, composition, 750, ±10% (X5 REG)	CTS	Series 65
R8312	0234 8470	12K	CGW	C-20
R8313	0236 0270	10K, ±1%	CGW	NI-20
R8314	0235 8510	226, ±1%	CGW	NI-20
R8316	0235 8480	210, ±1%	CGW	NI-20
R8317	0236 0390	13K, ±1%	CGW	NI-20
R8318	0203 0160	composition, 47	ALB	EB
R8319	0235 4380	composition, 100, ¼W	ALB	CB
R8320	0203 0900	composition, 56K	ALB	EB
R8321	0236 0390	13K, ±1%	CGW	NI-20
R8322	0235 9340	1.4K, ±1%	CGW	NI-20
R8323 & R8324	0236 0290	10.5K, ±1%	CGW	NI-20
R8325	0228 5190	62K, ±1%	IRC	DCC
R8326	0235 9340	1.4K, ±1%	CGW	NI-20
R8327	0235 9690	3.01K, ±1%	CGW	NI-20
R8328	0235 9650	2.14K, ±1%	CGW	NI-20
R8329	0235 9200	1K, ±1%	CGW	NI-20
R8331 & R8332	0235 4380	100, ¼W	ALB	CB
R8333	0234 8250	1.5K	CGW	C-20
R8334	0234 9160	3K, IW	CGW	C-32
R8336	0234 9160	3K, IW	CGW	C-32
R8337	0203 0070	composition, 20	ALB	EB
R8338	0235 4260	composition, 33, ¼W	ALB	CB
R8339	0109 0700	variable, composition, 100, ±20% (X AMP LEVEL)	CTS	Series 65
R8340	0235 1760	7.8K, 5W	CGW	LPI-5
R8341	0235 4260	composition, 33, ¼W	ALB	CB
R8342	0235 1760	7.8K, 5W	CGW	LPI-5
R8343 & R8344	0235 1750	2.1K	CGW	LPI-5
R8345 & R8346	0235 1760	7.8K, 5W	CGW	LPI-5
R8347	0235 9200	1K, ±1%	CGW	NI-20
R8348	0235 4380	composition, 100, ¼W	ALB	CB
R8400	0203 1030	composition, 200K, ±5%	ALB	EB
R8401	0234 8080	300	CGW	C-20
R8402	0236 0450	15K, ±1%	CGW	NI-20
R8403	0235 9850	4.32K, ±1%	CGW	NI-20
R8404	0234 8210	1K	CGW	C-20
R8406	0234 5120	wire wound, 3.6K, 3K	DAL	CS-2B
R8407	0234 7970	100	CGW	C-20
R8408	0236 2800	wire wound, 10K, 2W	DAL	CS-2A
R8409	0203 0100	composition, 27	ALB	EB
R8410	0234 8040	200	CGW	C-20
R8411	0234 0950	wire wound, 6K, 5W	WDL	5X
R8412	0236 0100	7.5K, ±1%	CGW	C-20
R8413	0235 9750	3.4K, ±1%	CGW	NI-20
R8414	0203 1080	composition, 330K	ALB	EB
R8415	0203 0750	composition, 13K	ALB	EB
R8416	0228 7120	499, ±1%, IW	CGW	SI-20
R8417	0234 8410	6.8K	CGW	C-20
R8418	0203 1090	composition, 360K	ALB	EB
R8419	0234 8290	2.2K	CGW	C-20
R8420	0203 1030	composition, 200K, ±5%	ALB	EB
R8421	0203 0000	composition, 10	ALB	EB
R8422	0234 8140	510	CGW	C-20
R8423	0203 0000	composition, 10	ALB	EB
R8424	0236 3150	360K	CGW	C-20
R8425	0203 0750	composition, 13K	ALB	EB
R8426	0234 8410	6.8K	CGW	C-20
R8427	0234 8290	2.2K	CGW	C-20
R8428	0234 8140	510	CGW	C-20
R8440	0203 0000	composition, 10	ALB	EB
R8441	0239 1359	430, 2W	ABD	
R8442	0236 0690	24.9K, ±1%	CGW	NI-20
R8443	0235 9600	2.49K, ±1%	CGW	NI-20
R8444	0239 1359	430, 2W	ABD	
R8445	0234 8190	820	CGW	C-20
R8501	0239 0268	1.2M, ±1%	ABD	
R8502	0239 0271	2M, ±1%	ABD	
R8503	0239 0272	4M, ±1%	ABD	
R8504	0239 0265	400K, ±1%	ABD	
R8506	0239 0264	200K, ±1%	ABD	
R8507	0239 0263	120K, ±1%	ABD	
R8508	0239 0262	40K, ±1%	ABD	
R8509 & R8510	0239 0261	20K, ±1%	ABD	
R8511	0239 0251	18M, ±1%, IW	ABD	
R8512	0239 0241	9M, ±1%	ABD	
R8513	0239 0242	5.4M, ±1%	ABD	
R8514	0239 0269	1.8M, ±1%	ABD	
R8516	0239 0267	900K, ±1%	ABD	
R8517	0239 0266	500K, ±1%	ABD	
R8551	0239 0268	1.2M, ±1%	ABD	
R8552	0239 0271	2M, ±1%	ABD	
R8553	0239 0272	4M, ±1%	ABD	
R8554	0239 0265	400K, ±1%	ABD	
R8556	0239 0264	200K, ±1%	ABD	
R8557	0239 0263	120K, ±1%	ABD	
R8558	0239 0262	40K, ±1%	ABD	
R8559 & R8560	0239 0261	20K, ±1%	ABD	
R8561	0239 0251	18M, ±1%, 1W	ABD	
R8562	0239 0241	9M, ±1%	ABD	
R8563	0239 0242	5.4M, ±1%	ABD	
R8564	0239 0269	1.8M, ±1%	ABD	

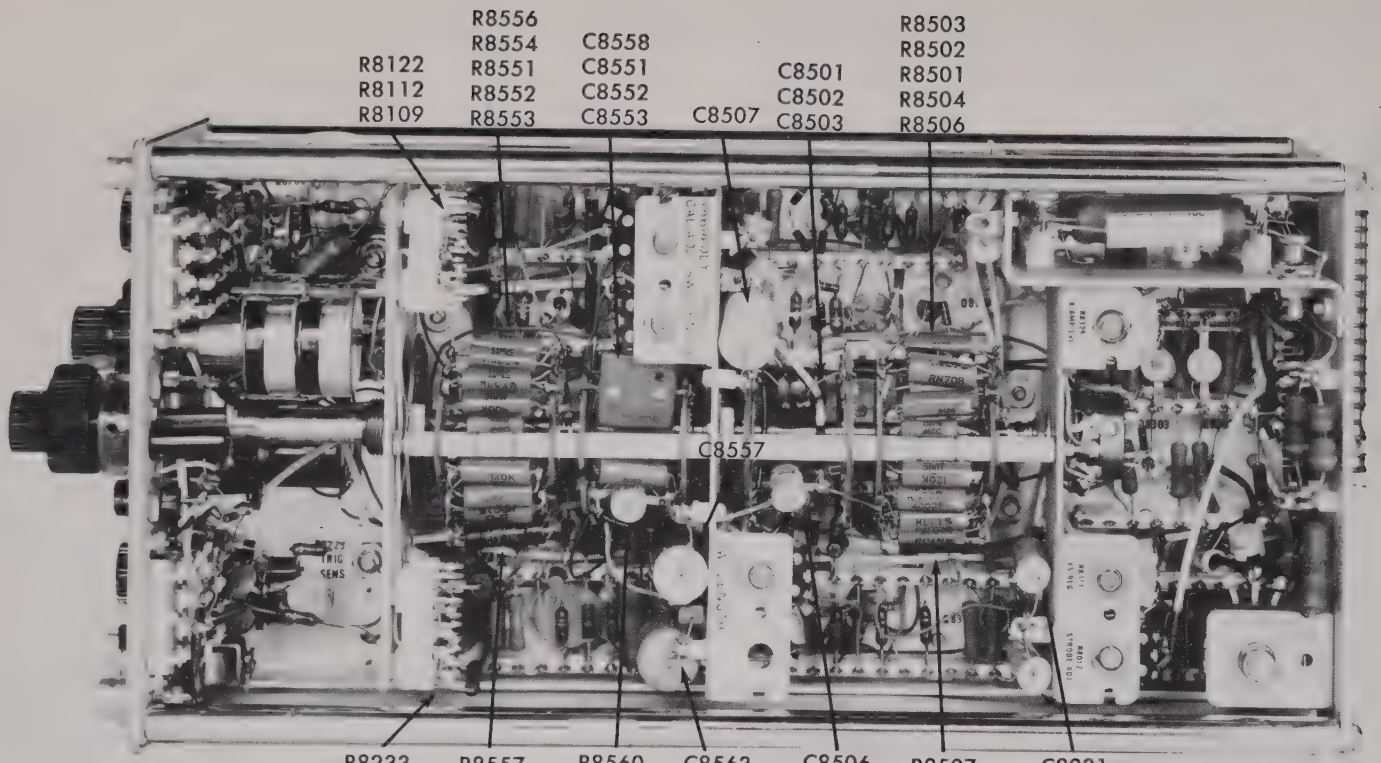


FIGURE 4-5. IDENTIFICATION OF REPLACEABLE PARTS
(Right Side View With Switch Components)

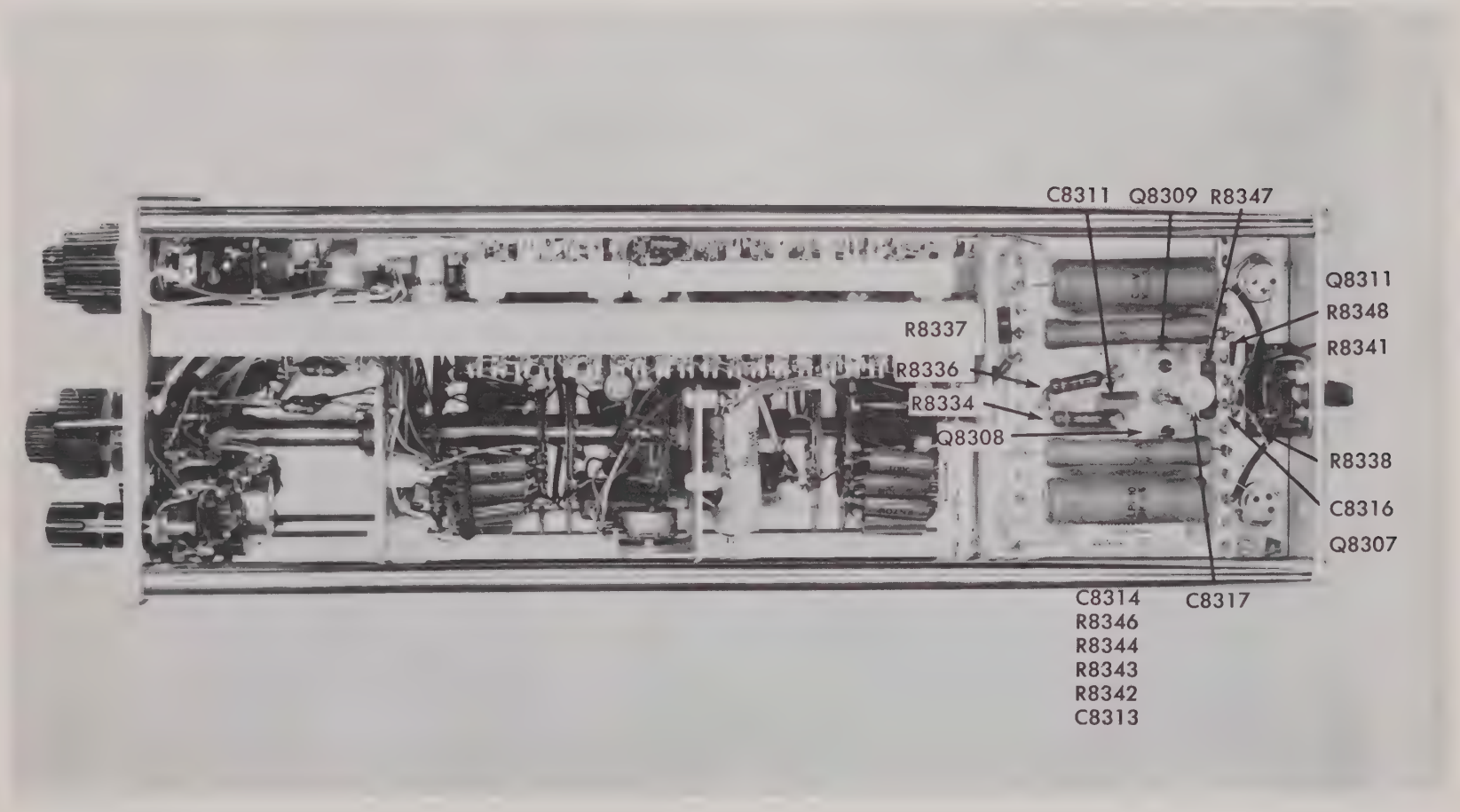


FIGURE 4-6. IDENTIFICATION OF REPLACEABLE PARTS (Top View)

Symbol	Part Number	Description	Recommended Vendor Code	Type
R8566	0239 0267	900K, ±1%	ABD	
R8567	0239 0266	500K, ±1%	ABD	
R8601	0203 0110	composition, 30	ALB	EB
R8602	0203 1620	composition, 56, ±10%	ALB	EB
R8603	0234 8450	10K	CGW	C-20
R8604	0235 4380	composition, 100, ¼W	ALB	CB
R8607	0234 8690	100K	CGW	C-20
R8608	0239 1382	3K, 2W	ABD	
R8609	0234 5140	wire wound, 4.7K, 3W	DAL	CS-2B
R8611	0203 0160	composition, 47	ALB	EB
R8612	0235 4380	composition, 100, ¼W	ALB	CB
R8613	0234 8690	100K	CGW	C-20
R8614 (74-11)	0203 0850	composition, 36K	ALB	EB
R8614 (74-13)	0109 0460	variable, wire wound, 4K, ±10%, 1.5W (DLY CAL ADJ)	CLS	49M
R8615	0203 2130	composition, 1M, ±10%	ALB	EB
R8616 (74-11)	0203 0480	composition, 1K	ALB	EB
R8616 (74-13)	0227 8690	wire wound, 9.1K, 5W	DAL	RS-5
R8617 F/R (74-11)	0101 8830	variable, composition, 20K/20K, ±20% (DELAY VERNIER)	CTS	Series C2-45
R8617 (74-13)	0109 0920	variable, wire wound, 2K, 2W (DELAY VERNIER)	CLS	Series 62JA
R8618 (74-11)	0203 1270	composition, 2M	ALB	EB
R8618 (74-13)	0109 0490	variable, composition, 250, ±20%, .3W (DELAY ZERO)	CTS	Series 70
R8619 (74-11)	0234 8660	75K	CGW	C-20
R8619 (74-13)	0239 1378	2.2K, 2W	ABD	
R8621	0234 8470	12K	CGW	C-20
R8622	0234 8490	15K	CGW	C-20
R8623	0236 0920	41.2K, ±1%	CGW	NI-20

SWITCHES

Symbol	Part Number	Description	Recommended Vendor Code	Type
S810 & S811	0503 2140	slide, DP3T (COUPLING)	MUT	No. 5608
S812	0503 1330	slide, DPDT (SLOPE)	STC	SS-50
S813 (part of R8111)	0107 2393	push-pull, 1 ampere, 125V, SPDT (EXT 1/10)	STC	
S820 & S821	0503 2140	slide, DP3T (S820 — SOURCE) (S821 — COUPLING)	MUT	No. 5608
S822	0503 1330	slide, DPDT (SLOPE)	STC	SS-50
S823 (part of R8222)	0107 2393	push-pull, 1 ampere, 125V, SPDT (EXT 1/10)	STC	
S830	0501 6961	slide, DPDT (PULL 5X)		
S840	0501 6951	2 sections, 5 positions, 60° (DISPLAY LOGIC)	OAK	
S850 (74-11)	0501 7001	rotary (TIME/CM)		
S850 (74-13)	0501 7002	rotary (TIME/CM)		
S851 (part of R8242)	0107 2661	rotary, linear, SPDT, 3 amperes, 125V	CTS	Series 45

TRANSFORMERS

Symbol	Part Number	Description	Recommended Vendor Code	Type
T8101	2001 3741	pulse		
T8201	2001 3741	pulse		
T8601	2001 3742	pulse	ABD	

ELECTRON TUBES

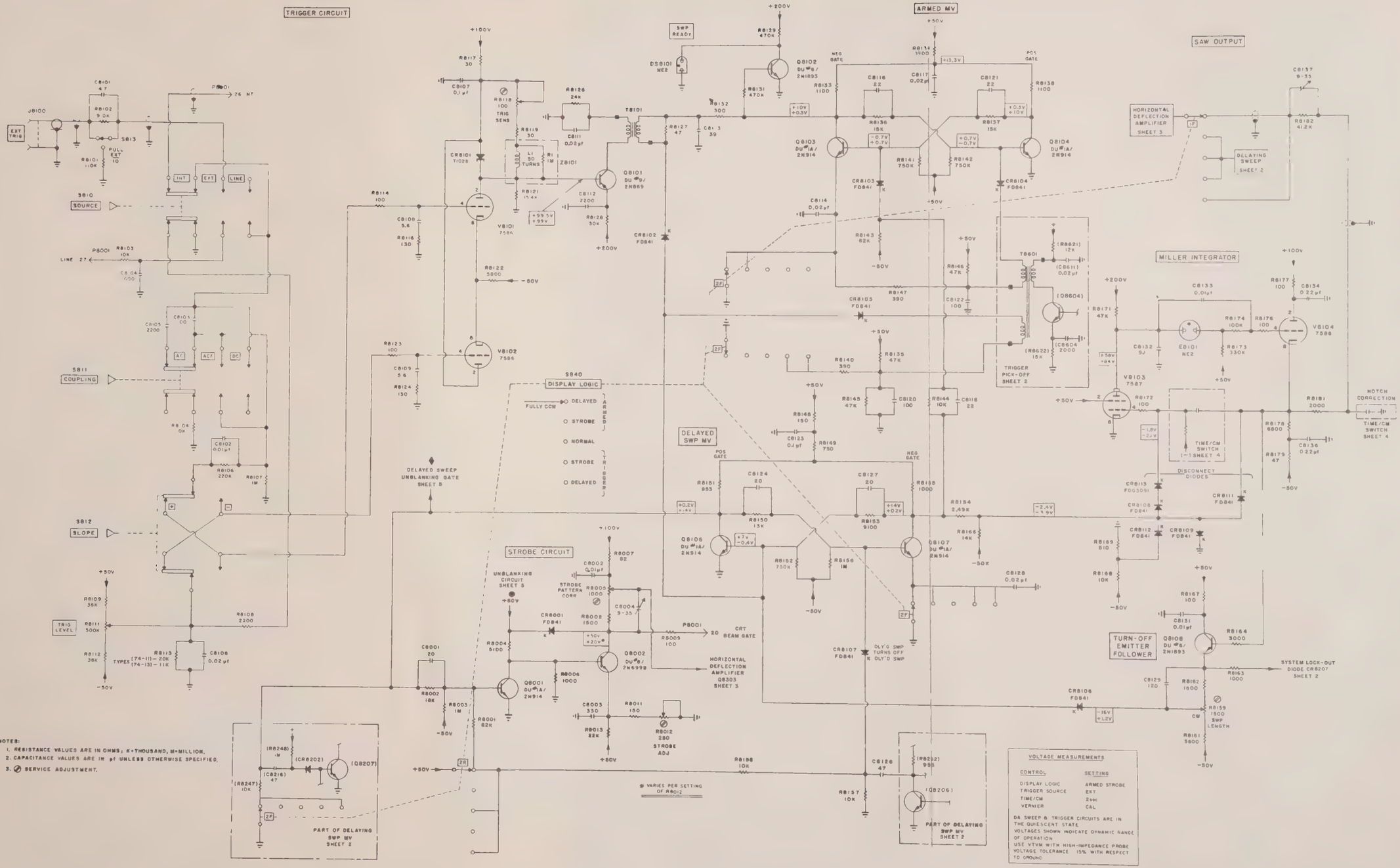
Symbol	Part Number	Description	Recommended Vendor Code	Type
V8101 & V8102	2501 3430	7586	RCA	"Nu-Vistor"
V8103	2501 3450	7587	RCA	"Nu-Vistor"
V8104	2501 3430	7586	RCA	"Nu-Vistor"
V8201 & V8202	2501 3430	7586	RCA	"Nu-Vistor"
V8203	2501 3450	7587	RCA	"Nu-Vistor"
V8204	2501 3430	7586	RCA	"Nu-Vistor"

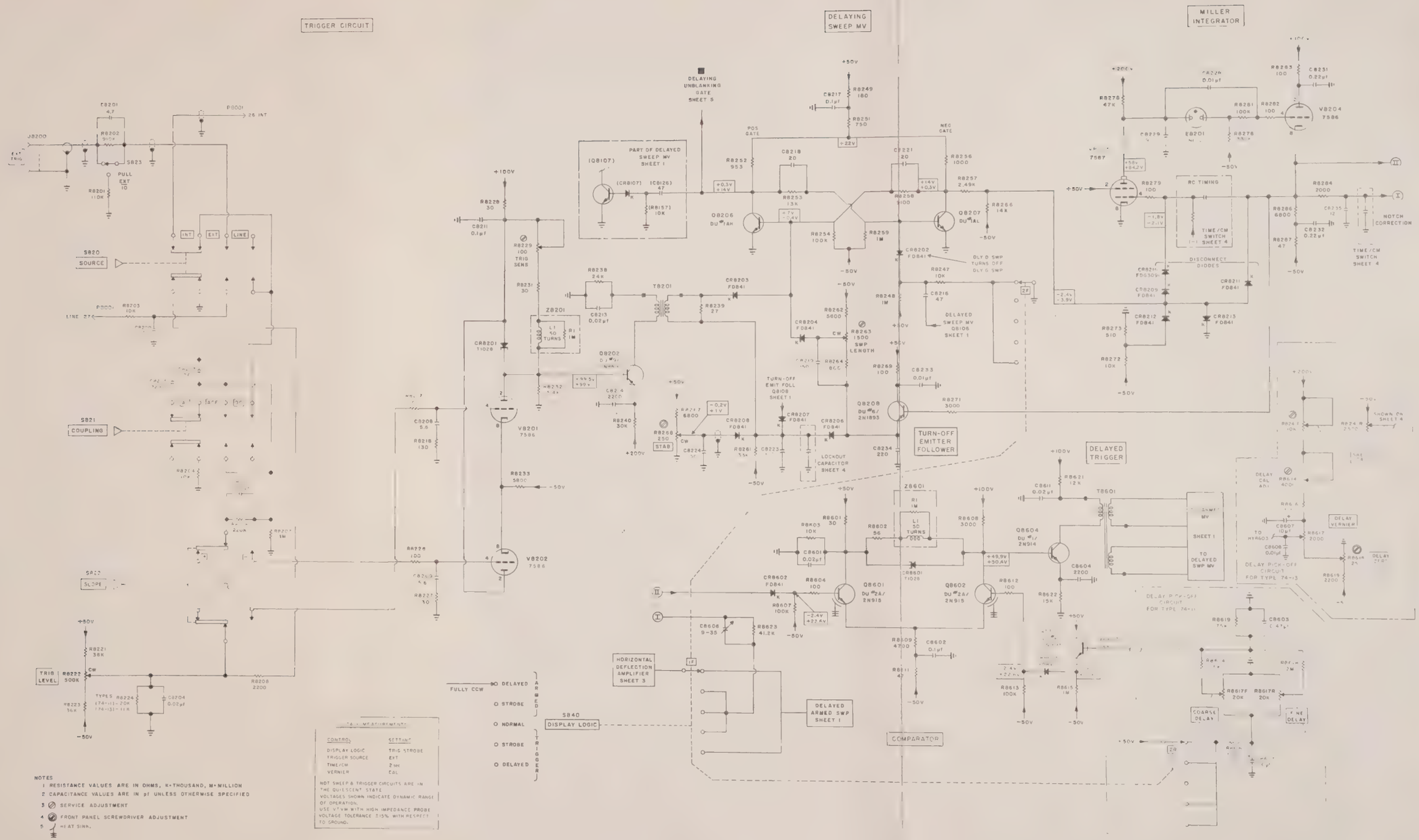
NETWORKS

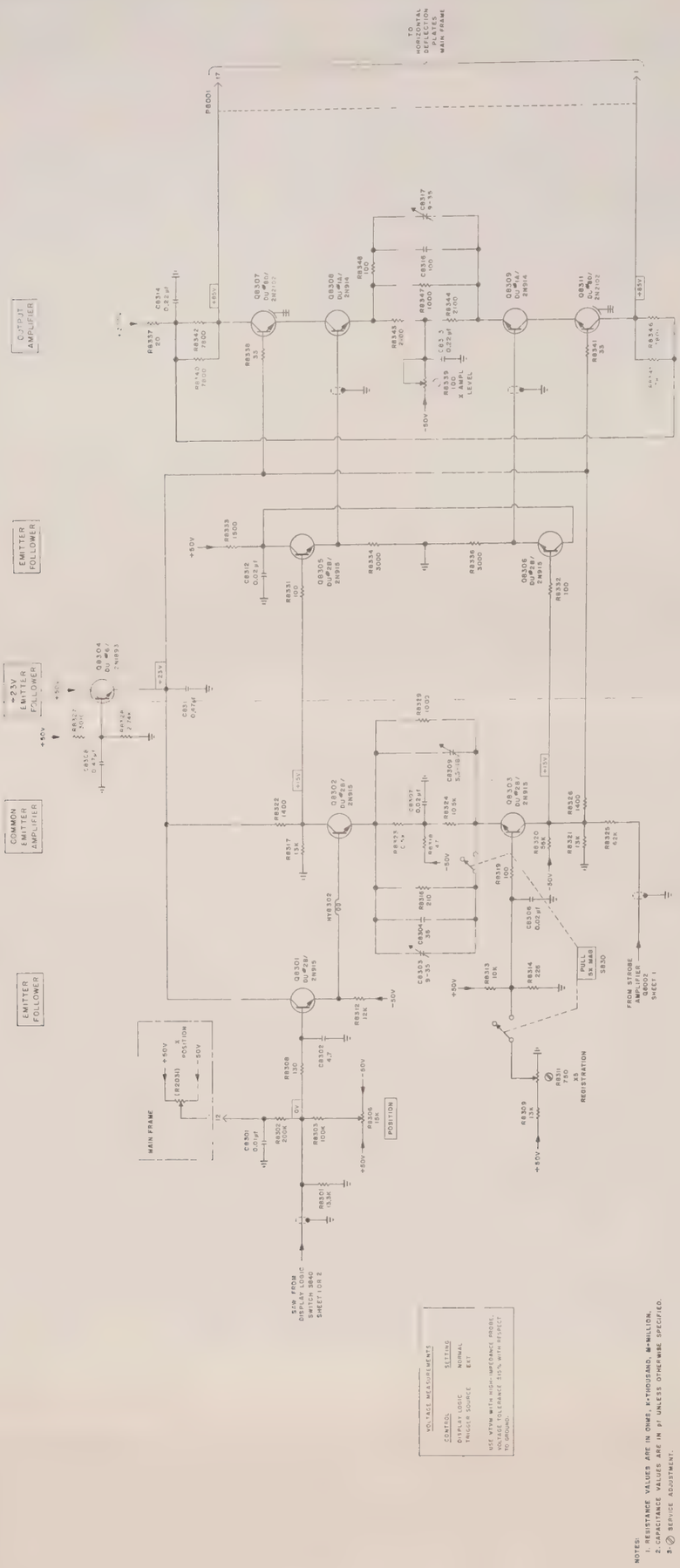
Symbol	Part Number	Description	Recommended Vendor Code	Type
Z8101, Z8201 & Z8601	8800 2336	peaking	ABD	

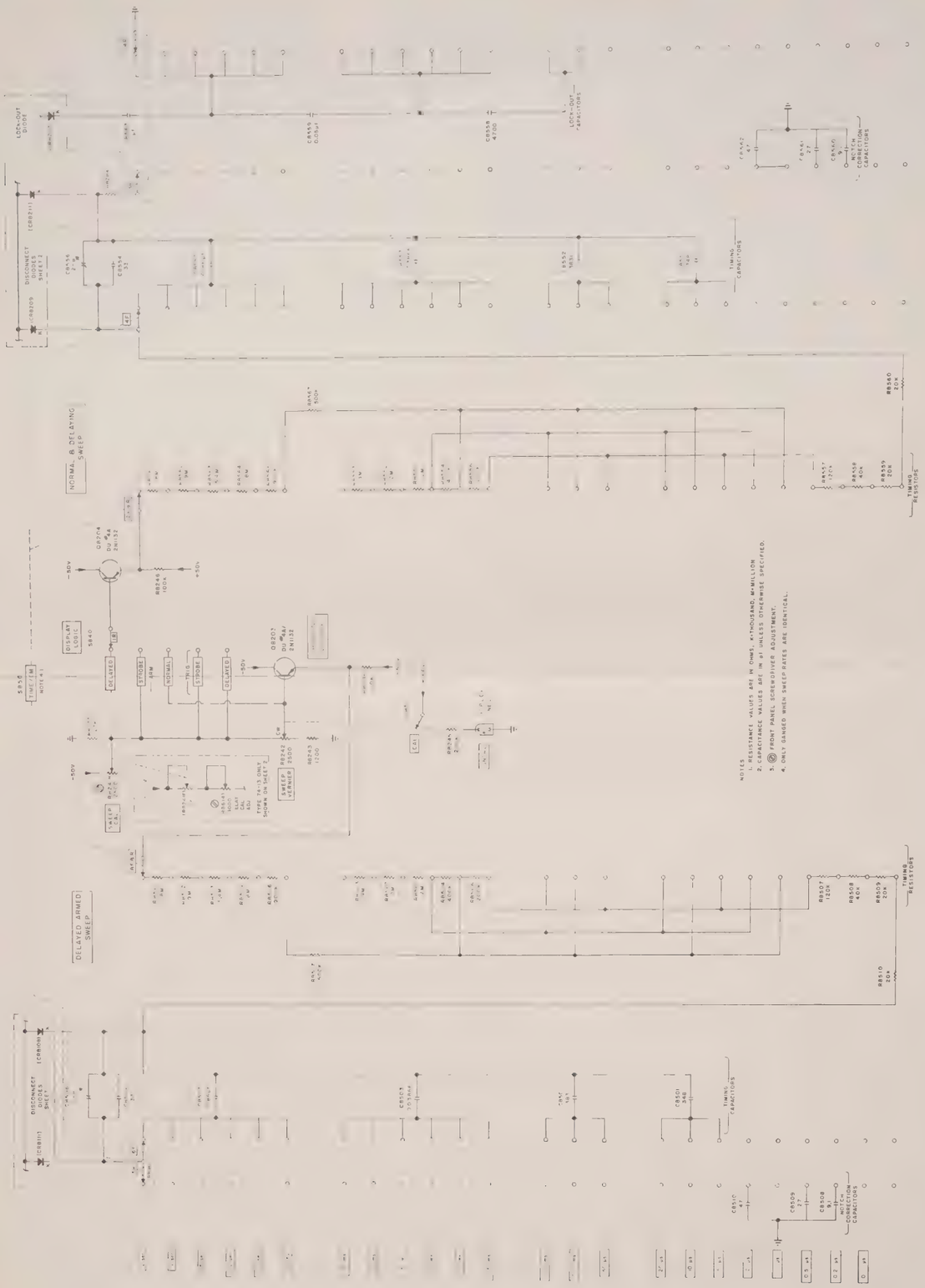
LIST OF RECOMMENDED VENDORS

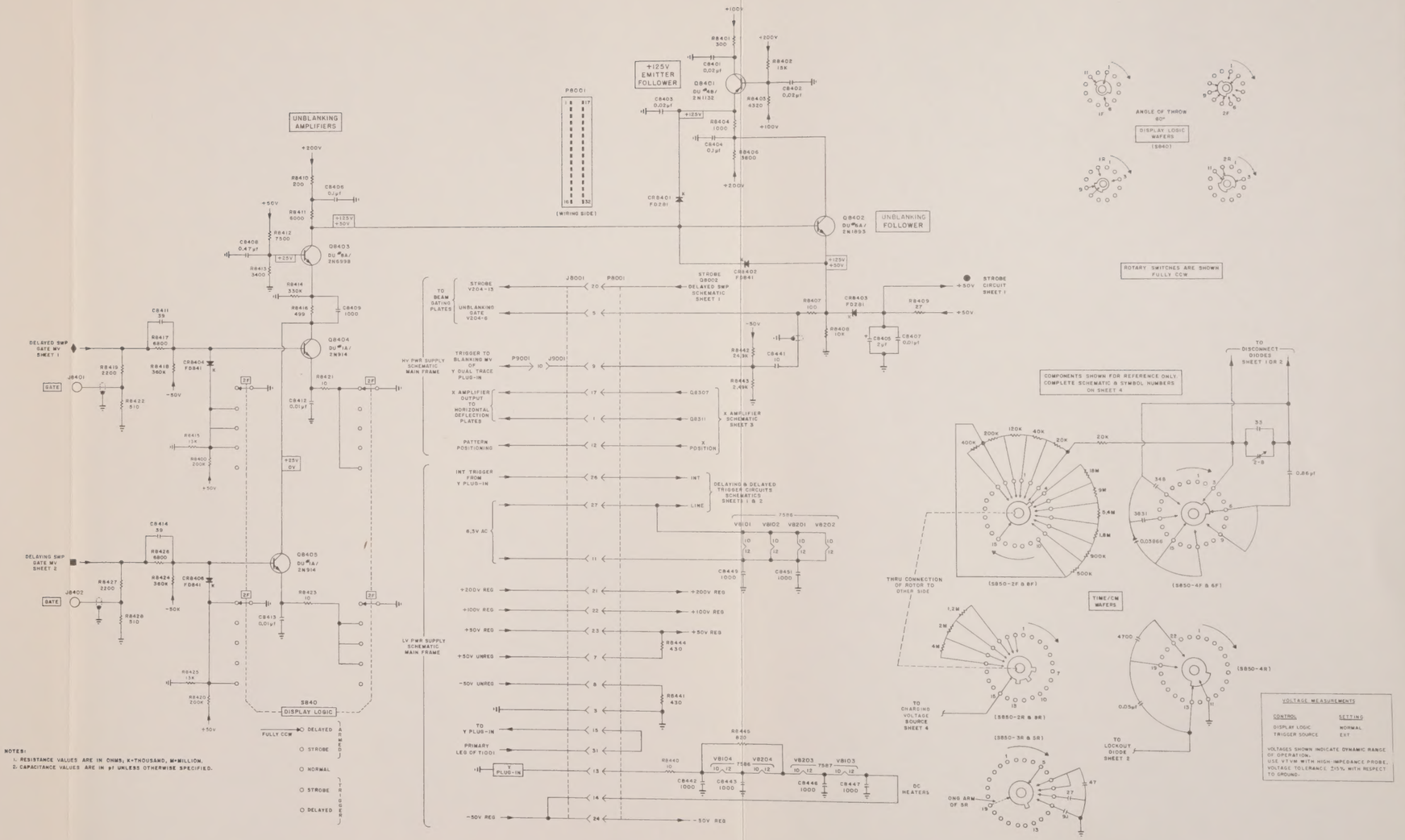
CODE	NAME
ABD	Allen B. Du Mont Laboratories
AER	Aerovox Corporation
AHH	Arrow-Hart & Hegeman Electric Company
ALB	Allen-Bradley Company
ALC	Allied Control
ALD	Alden Products Company
AMA	Amaton Electronic Hardware
AMP	Amp Inc.
AMR	Amperite Company, Inc.
AMX	Amperex Electronic Products Inc.
APC	American Phenolic Corporation
APH	Amphenol Electronics Corporation
ARC	Arco-Elemenco
AST	Astron Corporation
BUS	Bussmann Mfg. Co.
CAN	Cannon Electric Company
CBS	CBS-Hytron Division of CBS
CGW	Corning Glass Works
CH	Cutler-Hammer, Inc.
CHC	Chester Cable Corporation
CHM	Chatham Electronics
CLS	Clarostat Mfg. Co., Inc.
CDE	Cornell-Dubilier Electric Corporation
COC	Continental Carbon
CPC	C. P. Clare & Company
CRL	Centralab, Division of Globe-Union Inc.
CST	Chicago Standard Transformer
CTS	Chicago Telephone Supply Corporation
DAG	Dage Electric Company, Inc.
DAL	Dale Products, Inc.
DLC	Dialight Corporation
EBY	Hugh H. Eby, Inc.
EIA	Any manufacturer meeting EIA standards
ELC	Electra Mfg. Company
ELD	Eldema Corporation
EMC	Electro Motive Mfg. Company
ER	Eastern Radio
ERC	Erie Resistor Corporation
ESX	Essex Electronics
FCI	Fairchild Camera and Instrument Corporation
FER	Ferroxcube Corporation of America
GE	General Electric Company
GRC	General Radio Company
GRY	Grayhill, Inc.
GUD	The Gudeman Company
HOP	Hopkins Engineering Company
HWP	Hewlett-Packard Company
IRC	International Resistance Company
IRP	International Rectifier Corporation
ITT	ITT Components Division
JEF	Jeffers Electronics, Inc.
JHN	E. F. Johnson Company
JWM	J. W. Miller Co.
KUL	Kulka Electric Mfg. Co. Inc.
KXM	Klixon Metals and Control Corporation
LFI	Littlefuse, Inc.
MAL	P. R. Mallory & Company, Inc.
MIC	Micamold Electronics Mfg. Corporation
MIL	Miller Electric Company
MUT	The Muter Company
NYT	New York Transformer Company, Inc.
OAK	Oak Mfg. Company
PHC	Philco Corporation
PHI	Philips Electronic Tube Division
PLS	Plastoid Corporation
POT	Potter & Brumfield, Inc.
PRC	Precision Resistor Co., Inc.
PYR	Pyramid Electric Company
RCA	Radio Corporation of America
RMC	Radio Materials Corporation
ROY	Royal Electric Corp., Inc.
RTN	Rotron Mfg. Company
SLT	Sealectro Corporation
SPG	Sprague Electric Company
STC	Stackpole Carbon Company
STW	Standard Winding Company
SUM	Summit Coil Company
SYL	Sylvania Electric Products, Inc.
SYN	Syntronic Instruments, Inc.
TEC	Transistor Electronics Corporation
TEX	Texas Instruments, Inc.
THC	Thermal Control, Inc.
TOR	Torrington Mfg. Company
TRS	Tresco, Inc.
TRU	Tru-Ohm Products
TUG	Tung-Sol Electric Inc.
UCN	Ucinite Co.
VIC	The Victoreen Instrument Company
WDL	Ward Leonard Electric Company
WES	Weston Electrical Instrument Corporation
WYN	Welwyn International Inc.


TRIGGER CIRCUIT
ARMED MV
SAW OUTPUT
SWP READY
DSB101 NE2
+200V
+100V
+50V
-50V
-80V
Q8102 DUAL G/ 2N1893
Q8103 DUAL A/ 2N914
Q8104 DUAL A/ 2N914
R8129 470K
R8131 470K
R8132 300
R8133 1100
R8134 1900
R8136 15K
R8137 15K
R8138 1100
R8139 1000
R8140 390
R8141 750K
R8142 750K
R8143 82K
R8144 10K
R8145 47K
R8146 47K
R8147 390
R8148 150
R8149 750
C8114 0.02µf
C8116 22
C8117 0.02µf
C8118 22
C8120 100
C8121 22
C8122 100
C8123 0.1µf
C8128 0.02µf
CR8103 FD841
CR8104 FD841
CR8105 FD841
CR8102 FD841
T8101
Z8101
Q8101 DU PG/ 2N869
R8126 24K
C8111 0.02µf
R8127 47
C8113 39
R8128 30K
R8121 154K
C8112 2200
CR8101 T1028
R8117 30
C8107 0.1µf
R8118 100 TRIG SENS
R8119 30
L1 50 TURNS
R1 1M
V8101 7586
V8102 7586
R8114 100
C8106 5.6
R8116 130
R8122 5800
R8123 100
C8109 5.6
R8124 130
J8100 EXT TRIG
P8001 26 NT
C8101 47
R8102 9.0K
S813 PULL EXT 10
R8101 110K
S810 SOURCE
INT EXT LINE
P8001 LINE 27
R8103 10K
C8104 .050
S811 COUPLING
AC ACF DC
C8105 2200
C8103 .00
R8104 0K
C8102 0.01µf
R8106 220K
R8107 1M
S812 SLOPE
R8109 36K
TRIG LEVEL
R8111 500K
R8112 36K
R8113 TYPES (74-11)-20K (74-13)-11K
C8108 0.02µf
R8108 2200
S840 DISPLAY LOGIC
FULLY CCW
DELAYED
STROBE
NORMAL
STROBE
DELAYED
ARMED
TRIGGER
DELAYED SWEEP UNBLANKING GATE SHEET 5
DELAYED SWP MV
POS GATE
NEG GATE
Q8105 DUAL A/ 2N914
Q8107 DUAL A/ 2N914
R8150 13K
R8151 953
R8152 750K
R8153 9100
R8154 2.49K
R8156 1M
R8165 14K
C8124 20
C8127 20
C8129 120
STROBE CIRCUIT
UNBLANKING CIRCUIT SHEET 5
STROBE PATTERN CORE
C8002 0.01µf
R8005 1000
C8004 9-35
R8007 82
R8008 1500
R8009 100
P8001 20 CRT BEAM GATE
CR8001 FD841
Q8002 DUAL G/ 2N6998
HORIZONTAL DEFLECTION AMPLIFIER Q8303 SHEET 3
Q8001 DUAL A/ 2N914
R8004 5100
R8006 1000
C8001 20
R8002 18K
R8003 1M
R8001 82K
C8003 330
R8011 150
R8013 22K
R8012 280 STROBE ADJ
C8126 47
R8158 10K
R8157 10K
CR8107 FD841
DLY'G SWP TURNS OFF & DLY'D SWP
(R8212) 953
(Q8206)
PART OF DELAYING SWP MV SHEET 2
* VARIES PER SETTING OF R8012
(R8248) 1M
(CR8202)
(Q8207)
(C8216) 47
(R8247) 10K
PART OF DELAYING SWP MV SHEET 2
HORIZONTAL DEFLECTION AMPLIFIER SHEET 3
DELAYING SWEEP SHEET 2
C8137 9-35
R8182 41.2K
MILLER INTEGRATOR
(R8621) 12K
(C8611) 0.02µf
T8601
(Q8604)
(C8604) 2000
(R8622) 15K
TRIGGER PICK-OFF SHEET 2
C8133 0.01µf
C8132 9µ
E8101 NE2
R8174 100K
R8173 330K
R8176 100
R8177 100
C8134 0.22µf
V8104 7586
R8171 47K
V8103 7587
R8172 100
R8181 2000
R8178 6800
R8179 47
C8136 0.22µf
NOTCH CORRECTION
TIME/CM SWITCH SHEET 4
TIME/CM SWITCH 1-13 SHEET 4
DISCONNECT DIODES
CR8113 FD03091
CR8108 FD841
CR8111 FD841
CR8112 FD841
CR8109 FD841
R8169 810
R8168 10K
TURN-OFF EMITTER FOLLOWER
Q8108 DU PG/ 2N1893
R8167 100
C8131 0.01µf
R8164 3000
R8163 1000
SYSTEM LOCK-OUT DIODE CR8207 SHEET 2
C8129 120
R8162 1800
R8159 1500 SWP LENGTH
R8161 5600
CR8106 FD841
VOLTAGE MEASUREMENTS
CONTROL
SETTING
DISPLAY LOGIC
ARMED STROBE
TRIGGER SOURCE
EXT
TIME/CM
2 sec
VERNIER
CAL
DA SWEEP & TRIGGER CIRCUITS ARE IN THE QUIESCENT STATE.
VOLTAGES SHOWN INDICATE DYNAMIC RANGE OF OPERATION.
USE VTVM WITH HIGH-IMPEDANCE PROBE.
VOLTAGE TOLERANCE 15% WITH RESPECT TO GROUND.
NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN µf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.


TRIGGER CIRCUIT
DELAYING SWEEP MV
MILLER INTEGRATOR
DELAYED TRIGGER
TURN-OFF EMITTER FOLLOWER
COMPARATOR
HORIZONTAL DEFLECTION AMPLIFIER SHEET 3
DELAYED ARMED SWP SHEET 1
DELAYING UNBLANKING GATE SHEET 5
LOCKOUT CAPACITOR SHEET 4
DELAYED SWEEP MV Q8106 SHEET 1
TURN-OFF EMITTER FOLLOWER Q8108 SHEET 1
RC TIMING
TIME/CM SWITCH SHEET 4
DISCONNECT DIODES
NOTCH CORRECTION
DELAY PICK-OFF CIRCUIT FOR TYPE 74-13
DELAY PICK-OFF CIRCUIT FOR TYPE 74-11
SHOWN ON SHEET 4
TO DELAYED SWP MV SHEET 1
TO HYA803
DELAY VERNIER
COARSE DELAY
FINE DELAY
J8200
EXT TRIG
P8001
26 INT
PULL EXT 10
S820 SOURCE
INT
EXT
LINE
S821 COUPLING
S822 SLOPE
TRIG LEVEL R8222 500K
CW
V8201 7586
V8202 7586
V8204 7586
Z8201
T8201
Q8206 DUAL FET
Q8207 DUAL FET
Q8208 DUAL 2N1893
Q8601 DUAL 2N915
Q8602 DUAL 2N915
Q8604 DUAL 2N914
FULLY CCW
DELAYED
STROBE
NORMAL
STROBE
DELAYED
ARMED
TRIGGER
S840 DISPLAY LOGIC
CONTROL
SETTING
DISPLAY LOGIC
TRIG STROBE
TRIGGER SOURCE
EXT
TIME/CM
2 MS
VERNIER
CAL
NOT SWEEP & TRIGGER CIRCUITS ARE IN THE QUIESCENT STATE
VOLTAGES SHOWN INDICATE DYNAMIC RANGE OF OPERATION.
USE VTVM WITH HIGH IMPEDANCE PROBE
VOLTAGE TOLERANCE ±15% WITH RESPECT TO GROUND.
NOTES
1 RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION
2 CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED
3 SERVICE ADJUSTMENT
4 FRONT PANEL SCREWDRIVER ADJUSTMENT
5 HEAT SINK


OUTPUT AMPLIFIER
EMITTER FOLLOWER
-23V EMITTER FOLLOWER
COMMON EMITTER AMPLIFIER
EMITTER FOLLOWER
MAIN FRAME
POSITION
REGISTRATION
TO HORIZONTAL DEFLECTION PLATES, MAIN FRAME
FROM STROBE AMPLIFIER Q8002 SHEET 1
FROM DISPLAY LOGIC SWITCH S840 SHEET 1 OR 2
VOLTAGE MEASUREMENTS
CONTROL
SETTING
DISPLAY LOGIC
NORMAL
TRIGGER SOURCE
EXT
USE VTVM WITH HIGH-IMPEDANCE PROBE. VOLTAGE TOLERANCE ±10% WITH RESPECT TO GROUND.
NOTES:
1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. HEAT SINK.


NORMAL & DELAYING SWEEP
DELAYED ARMED SWEEP
TIMING RESISTORS
TIMING CAPACITORS
NOTCH CORRECTION CAPACITORS
DISCONNECT DIODES
LOOP-OUT DIODE
SWEEP CAL.
SWEEP LENGTH
NOTES
1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⓥ FRONT PANEL SCREWDRIVER ADJUSTMENT.
4. ONLY GANGED WHEN SWEEP RATES ARE IDENTICAL.


UNBLANKING AMPLIFIERS
+125V EMITTER FOLLOWER
UNBLANKING FOLLOWER
P8001
(WIRING SIDE)
+200V
+100V
+50V
+125V
-50V
DELAYED SWP GATE MV SHEET 1
DELAYING SWP GATE MV SHEET 2
GATE
J8401
J8402
S840
DISPLAY LOGIC
FULLY CCW
DELAYED
STROBE
NORMAL
STROBE
DELAYED
ARMED
TRIGGER
NOTES:
1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
TO BEAM DEFLECTING PLATES
STROBE V204-15
UNBLANKING GATE V204-6
HV PWR SUPPLY SCHEMATIC MAIN FRAME
TRIGGER TO BLANKING MV OF Y DUAL TRACE PLUG-IN
X AMPLIFIER OUTPUT TO HORIZONTAL DEFLECTION PLATES
PATTERN POSITIONING
X AMPLIFIER SCHEMATIC SHEET 3
INT. TRIGGER FROM Y PLUG-IN
DELAYING & DELAYED TRIGGER CIRCUITS SCHEMATICS SHEET 1 & 2
6.3V AC
LV PWR SUPPLY SCHEMATIC MAIN FRAME
TO Y PLUG-IN
PRIMARY LEG OF T1001
Y PLUG-IN
DC HEATERS
STROBE CIRCUIT SHEET 1
STROBE Q8002 DELAYED SWP SCHEMATIC SHEET 1
ROTARY SWITCHES ARE SHOWN FULLY CCW
COMPONENTS SHOWN FOR REFERENCE ONLY. COMPLETE SCHEMATIC & SYMBOL NUMBERS ON SHEET 4
TO DISCONNECT DIODES SHEET 1 OR 2
ANGLE OF THROW 60°
DISPLAY LOGIC WAFERS (S8401)
(S850-2F & 2R)
(S850-4F & 4R)
THRU CONNECTION OF ROTOR TO OTHER SIDE
TIME/CM WAFERS
TO CHARGING VOLTAGE SOURCE SHEET 4
(S850-2R & 3R)
(S850-3R & 5R)
(S850-4R)
ONE ARM OF 5R
TO LOCKOUT DIODE SHEET 2
VOLTAGE MEASUREMENTS
CONTROL
SETTING
DISPLAY LOGIC
NORMAL
TRIGGER SOURCE
EXT
VOLTAGES SHOWN INDICATE DYNAMIC RANGE OF OPERATION. USE VTVM WITH HIGH IMPEDANCE PROBE. VOLTAGE TOLERANCE ±15% WITH RESPECT TO GROUND.